

No.32

NOVEMBER/ DECEMBER 1995 £2.95

MODEL ENGINEERS'

# WORKSHOP

THE PRACTICAL HOBBY MAGAZINE



## SHAPING A VEE BLOCK

*Generated geometry*

## 2-JAW CHUCK

*Take a firm grip on awkward shapes*

## DATA BOOK

*More pages for your folder*

## MACHINE TOOLS

*Inspection, overhaul and shifting*

THE 65th  
**model**

ENGINEER EXHIBITION

*at The International Model Show*

OLYMPIA 30 DECEMBER - 6 JANUARY 1996



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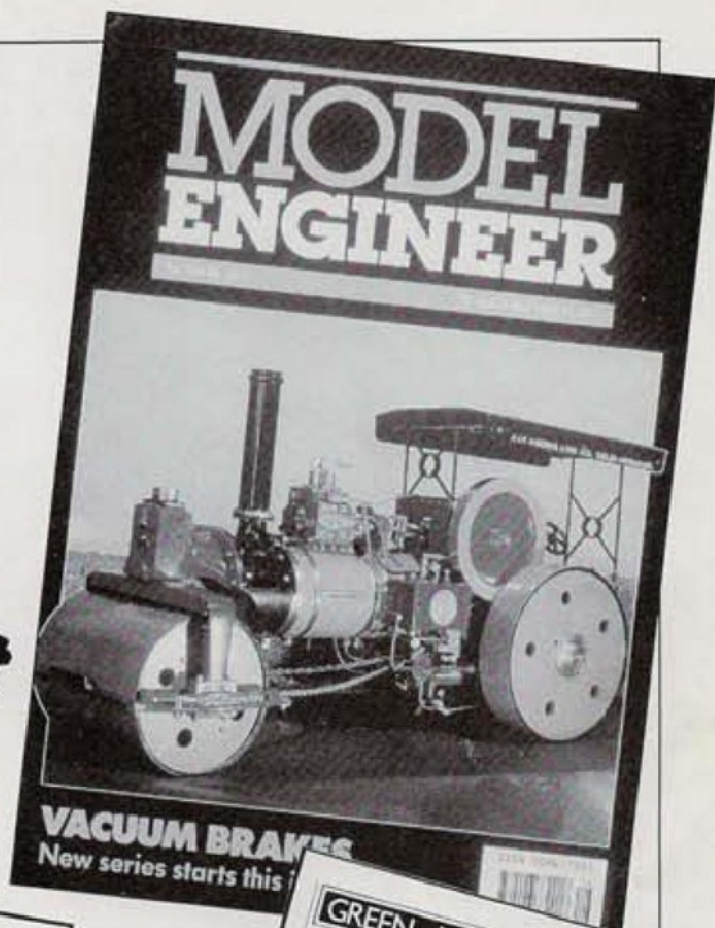


NEXUS



# SOMETHING TO LOOK FORWARD TO...

...every fortnight



There's something to anticipate twice every month in fascinating Model Engineer magazine! Whether your interests lie in live steam locomotive models, traction engines, internal combustion motors or stationary engines, world famous M.E. will inspire, instruct, advise and encourage. Model Engineer is published on the first and third Fridays each month and costs just £1.40 from all good newsagents; alternatively, you may care to ensure your regular copies through an annual subscription - a mere £33.60 for UK readers (overseas rates and airmail details on request).

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Argus House,  
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Issue No.

32

Editor: Geoff Sheppard

Nexus Speal interests, Nexus House, Boundary Way, Hemel Hempstead, HP2 7ST, tel. 0442 66551

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*Archaic - not necessarily; this elderly hand shaper gave very acceptable results in machining these Vee blocks, all is revealed on page 40.*

## ON THE COVER

*Seen at the Camden Works Museum in Bath was this elderly, but still usable milling machine. Apposite for this issue, which is largely devoted to acquiring and renovating larger machine tools.*



*Apart from the obvious turning on this swivel base, the remainder is work carried out on the drilling machine and finished by hand methods. The article on page 21 gives the method and is well worth careful study.*



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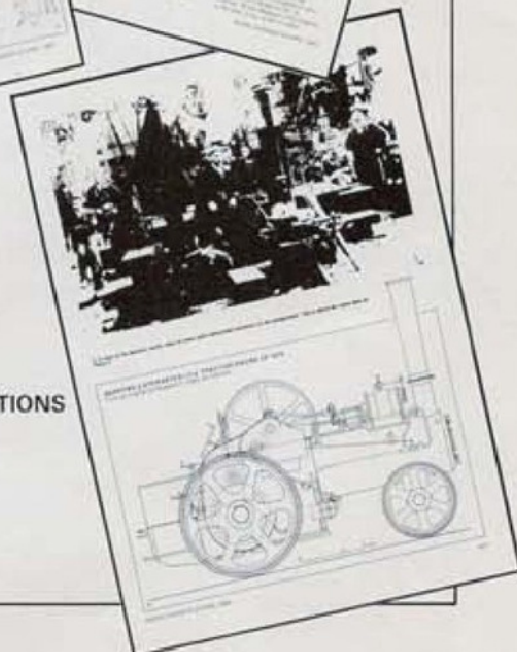
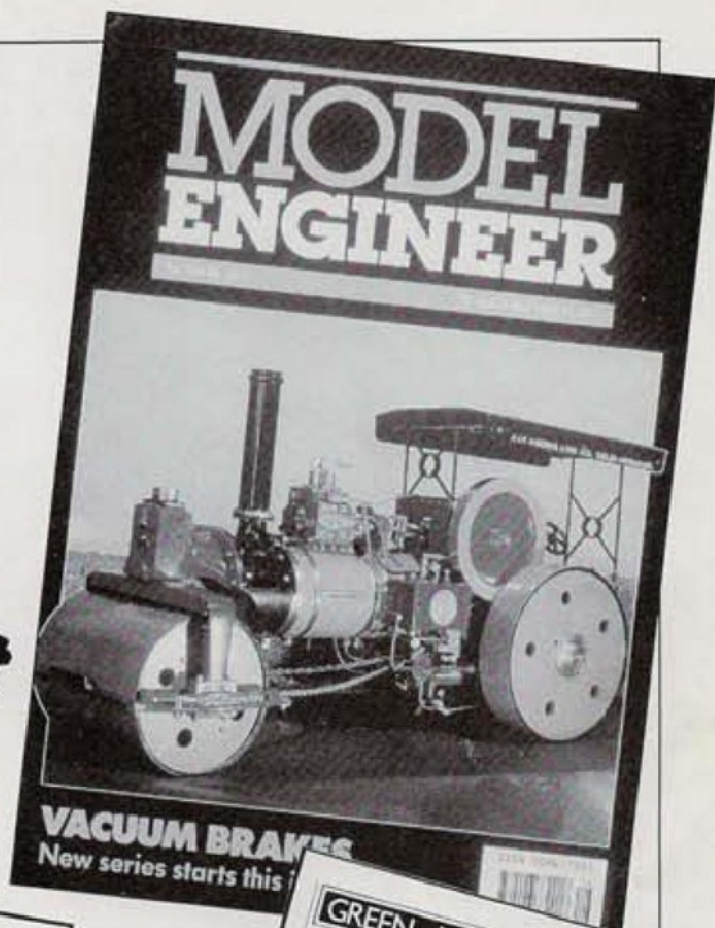
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## ON THE EDITOR'S BENCH

I write these notes just as the evening class season is about to start. This and a letter from a reader in Putney, South-west London, have caused me to reflect on how newcomers to our hobby can obtain the very basic knowledge which is necessary to cut, form and join metals and other engineering materials. In past years, the majority of secondary and grammar schools had some form of workshop which housed fitting benches, a drilling machine and at least one lathe. Then came a period when these facilities became much more elaborate, but then things seemed to go in the other direction. The best source of reasonable second-hand machinery appeared to be the local school workshop, which was being dismantled because the curriculum being followed no longer included such subjects.

The demise of the school workshop also curtailed the availability of evening class course. Our local area, at one stage, could provide a choice of six or seven classes in any week. Now we seem to be down to just one. In addition to providing access to much larger and versatile machinery than most of us could accommodate in our home workshops, there was always someone, in addition to the instructor, who was able and willing to help the less experienced to find the way to tackle a job. The social aspects also proved valuable, when many would adjourn to the 'local' for the last hour, a period which was as enjoyable and instructive as the class itself. Many a new miniature locomotive project has been sketched out on a beer mat!

Tangible evidence of the success of this interchange and that which takes place at local model engineering society meetings has been seen many times. I well remember one expert ship modeller who had little knowledge of working metal, to the extent that it had to be explained how it was possible to generate a flat surface by using a lathe. Not many months later, he had produced a Championship Cup winning motor launch, powered by a single cylinder i.c. engine for which he had made patterns, castings and all the machined items.

Some societies still own and operate their own workshops, but how the European Machinery Directive is likely to affect them remains to be seen. It does seem that the hobby workshop activity is again one which has to be carried out in

private. I keep hearing it said that most model engineers are 'loaners', but I have found that, given the right circumstances, they can be a sociable lot.

Our reader from Putney attends a technical college evening class, but is seeking more intensive tuition in advanced workshop practices, perhaps on a one to one basis. The only instance of this sort of which I am aware, was when an enthusiastic teenager in the area was very keen to build a small locomotive, but had neither the equipment nor the knowledge. One of our club members welcomed him to his home and workshop as a house guest on many weekends, so that he could make a start and maintain his enthusiasm until a modest workshop could be established. A truly generous gesture, I feel. Does any of our readers have any idea as to how our friend from Putney can gain the experience he is seeking?

### Neighbourhood Engineers

I have received a number of letters in which readers regret the decline of the awareness of young people of the importance of engineering to society. The Engineering Council is keen to correct this, and has established the Neighbourhood Engineers scheme, with the aim of providing friendly, informal, practical and committed support to the daily life of local schools. Together with teachers, engineers form effective teams to consider how best the ingenuity and resourcefulness of individual volunteers can develop the 'engineering dimension' within the school.

Wherever practical, a team of at least five neighbourhood engineers serves each school. The ideal team includes an Engineering Technician, an Incorporated Engineer, a Chartered Engineer, a retired engineer and a School Co-ordinator.

I am sure that, if you are interested and have the relevant experience and expertise, your local group would welcome you.

### The Model Engineer Exhibition

Within this Issue, you will find details of the forthcoming 65th Model Engineer Exhibition, together with an entry form. I would encourage all readers of MEW to

consider sending an item to Olympia. If you do not feel that you wish to enter the Competition section, then what about a Loan item. I appreciate that the majority of tools and equipment are made to be used, and are not finished to 'concourse' standards. No matter, as long as they are fit for purpose and well made.

I would like to see a table crowded with items which have been made to designs published in MEW, so that we can show the rest of the modelling world what we get up to. If you would like to join in this exercise, please let me know as soon as possible.

The usual pick-up service will be operating, so there should be little problem in getting your exhibit transported there and back. Even if you are unable to support us with an entry, I look forward to meeting many of you there.

### Subscription Prize Draw Results.

In Issue 29 (May/June 1995), we advertised a Free Prize Draw to those taking out a subscription to MEW. I am pleased to publish the winners, as follows:-

#### First Prize: Free one year subscription.

S W Lawson, Leatherhead, Surrey

#### Second Prize: Free subscriptions for 6 months.

Mr J Scales, Crewe, Cheshire  
Mr P Du-Rose, Rugby, Warwickshire  
D J Leonard, St Agnes, Cornwall  
Mr S W James, Cardiff, South Glamorgan  
T W R Calway, County Down

#### Third Prize: Free Binder

O L Carlsson, Preston Lancashire  
A F Lane, Bristol, Avon  
P Haywood, York, North Yorkshire  
J B Gorst, Kendal, Cumbria  
Mr M Waldron, Southampton  
Mr P Gill, St Austell, Cornwall  
Mr & Mrs N Morgan, Suffolk  
F R Hudson, Lincolnshire

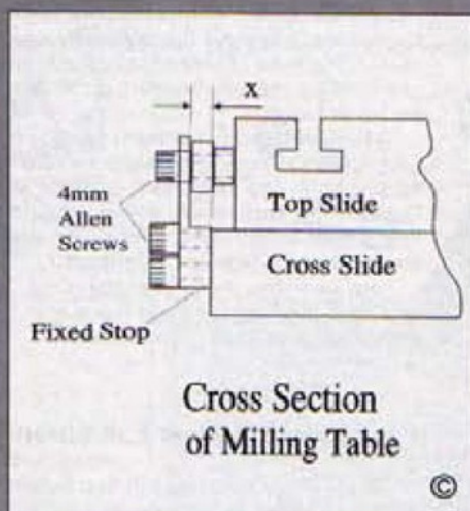
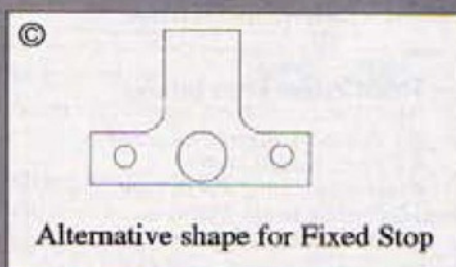
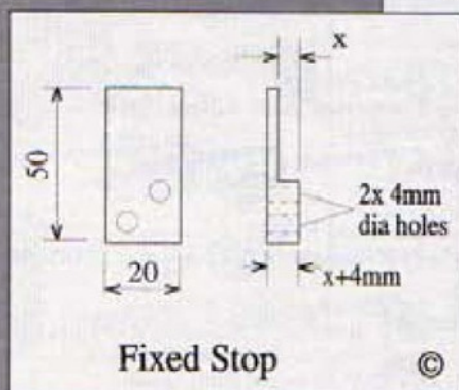
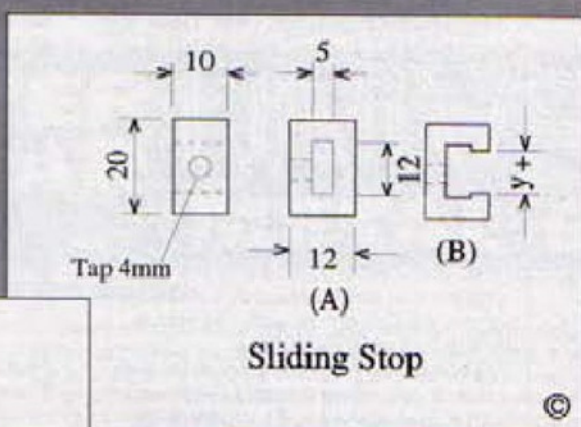
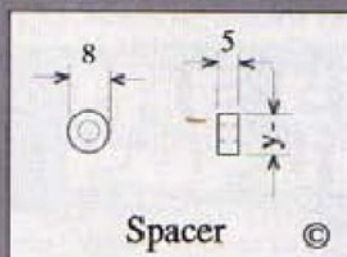
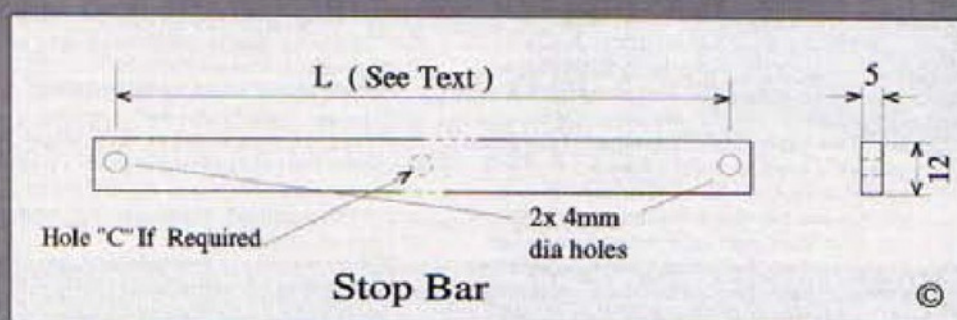


# ADJUSTABLE STOP BAR

## FOR A MILLING MACHINE

Brian Cocksedge brings us a simple attachment which will help in milling operations, and suggests some alternative arrangements.

### ADJUSTABLE STOP BAR



**A**mong the response to my request in M.E.W. for information on the Raglan Vertical Miller was a drawing for a table stop bar. I considered it was too complicated for my way of working, so I set the old grey matter into action and redesigned it. Realising that a lot of older machines, cheaper imports, and the new Myford VM-8 lack this useful item, it urged me into putting 'pen to paper'. (Fingers to keyboard actually).

I will describe how I made and fitted the stop bar to my Raglan Miller, and also throw a few alterations, and ideas into the melting pot. Some of the dimensions especially 'L' and 'x' will have to be adapted to fit your machine.

The stop bar was made from 12mm ( $\frac{1}{2}$ in.) x 5mm ( $\frac{3}{16}$ in.) black bar. I used black because I had a bit handy, you could use BMS it depends what you have available.

I decided to make the length 'L' 50mm (2in.) longer than the total table travel, this in my case giving a length of 400mm. I considered that, due to this short length, the strength of the bar was sufficient to omit the central hole 'C'. After drilling the two 4mm holes, I used the bar as a jig to mark out the hole positions on the

### QUICK TIP

#### Reducing bolt lengths

It is often necessary to reduce the length of even short bolts or screws, and it is often difficult to hold these in a vice for sawing.

Put a clearance hole in a thin plate which can be clamped in the vice. Assemble the bolt or screw with a nut and saw off. Don't forget to keep the plate for another time!

P W Pilkington



face of the table. (This was all done without dismantling the machine.) Clamping the bar central on the face of the table below any tee slots that may protrude, allowed the first 4mm hole to be marked out, drilled and tapped. The bar was then attached with the spacer and Allen screw. With a spirit level used to set the bar parallel to the top of the table, it was now possible to mark out, drill and tap the second hole (also 4mm). You could use a DTI to set the bar parallel, but I found that my spirit level was accurate enough, provided I checked it against the table top first.

I used 4mm x 20mm cap head Allen screws, but countersunk Allen screws would be better and if you use the central hole 'C' they are mandatory. If you use countersunk screws, countersink the stop bar so that they lie flush. Manufacture two sliding stops as in 'A' if you decide not to use the central hole, otherwise as 'B'. Machine and file the slot in the stops to a nice sliding fit to the bar, then drill and tap the 4mm holes. I used 4mm Allen screws, fitted with copper inserts to prevent damaging the stop bar.

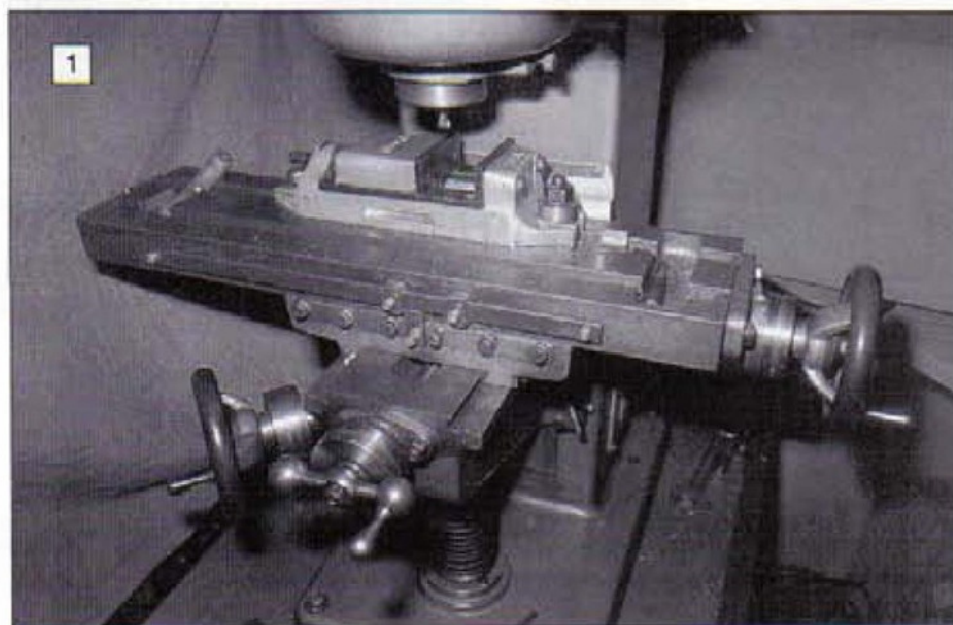
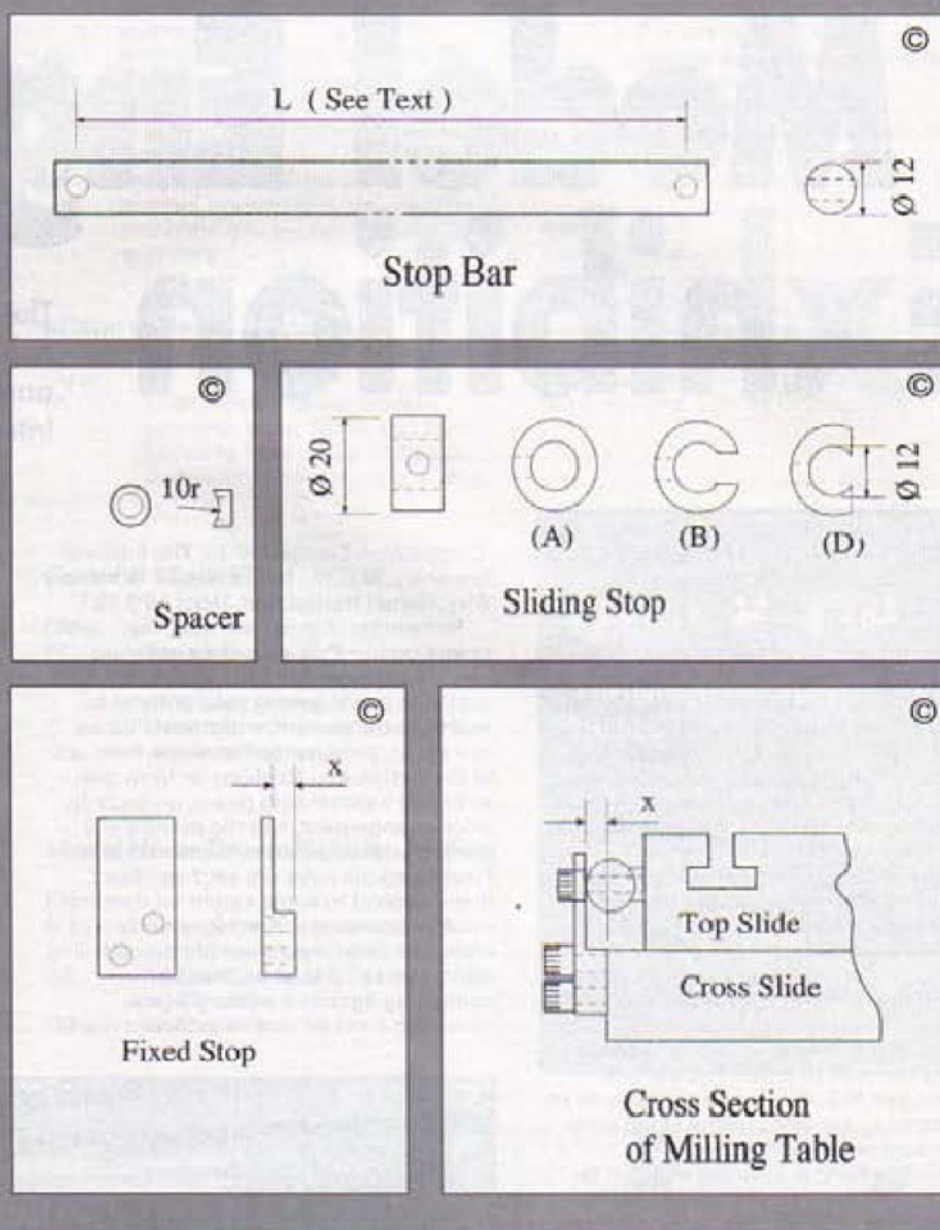
The fixed stop is manufactured from stock bar and machined to give dimension 'x'. This then bolts onto the cross-slide of the miller. Dimension 'x' will depend on how much your table overhangs the cross-slide (see Drawing and cross section for details).

## Alternatives

**Photo 1** shows an early version fitted to my miller. An improved fixed stop could be manufactured and I expect to have made that modification by the time you read this. (see the alternative fixed stop drawing.)

The slide bar could be made from 12mm dia. bar and the sliding stop manufactured as shown in the alternative drawings. The sliding stops will consequently be easier to manufacture out of round stock, bored to size. The sliding stop will have to be slotted to clear the spacer if the central

# ALTERNATIVE STOP BAR



hole 'C' is used (as detail 'B'), or made as shown at detail 'D' if you leave out the spacers. I would advise that spacers are used, otherwise swarf will collect between the bar and the table and consequently will have to be cleaned every time the sliding stops are moved.

I am sure that additional sliding stops could be adapted to fix a safety screen to the miller, but that's another story



## QUICK TIP

### Tapping blind holes

Try a spiral flute tap for tapping blind holes. They bring the swarf up out of the hole, allowing you to tap to full depth without having to remove the tap to clear the swarf.

D N Crossley



# The 65th Model Engineer Exhibition

The 65th Model Engineer Exhibition is to be enlarged and amalgamated into the new International Model Show

**T**his year's Model Engineer Exhibition, to be held at Olympia from 30 December until 6 January 1996, will be enlarged and amalgamated into a new show, entitled - The International Model Show and The Model Engineer Exhibition.

This new show will cover a much larger area with the West Hall, at the rear of the Grand Hall, being opened up as a radio controlled car racing track and a go-kart track. The Grand Hall will feature all the modelling disciplines, including a boat pool in the centre surrounded by competitions, displays and all the trade and club stands, whereas the General Modelling section and Flying Hall will be near the main entrance.

Competitions are traditionally a major feature of the Model Engineer Exhibition and they will also form a very prominent part of the International Model Show and now is the time to enter! The various classes that M.E.W. readers are likely to be interested in are listed below along with those for the Junior Section.

An entry form is included overleaf for your convenience so don't delay - fill one out today. Who knows, your exhibit just might win a medal! Loan models (including part built) and entries for the Micro Steam Car Challenge Competition may also be entered on the form. Photocopies are acceptable for multiple entries, or for those who do not wish to deface their magazine. If you have a friend who is not a subscriber feel free to pass on a photocopy of these two pages. Competition entries for items entered in the classes listed below, and for Loan Section or the Micro Steam Car Challenge should be sent to M.E.W. Editorial Secretary, Model Engineer Exhibition Entries, Nexus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST. Remember that the Judges may, if they feel that the exhibit would be better in another category move it from one class to another.

If you require a full list of Competition Classes for The 65th Model Engineer Exhibition, at The International Model Show, please send a self-addressed, stamped A4 envelope (approx. 320mm x 230mm) inside an envelope clearly marked

'Competition Categories' to: The Editorial Secretary, M.E.W., Nexus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST.

Remember that we will again be operating our Pick up service covering various locations around the U.K., so it is probable that if getting your entry(s) to and from the show is a problem that we can assist, pick-ups can be made from any of the designated locations or from pre-arranged intermediate points on route by prior arrangement, and the models will generally be returned to the same location. Final locations have not yet been fixed, these depend to some extent on demand.

All entries are judged for standard of craftsmanship, regardless of the modelling discipline, i.e., a boat will not be competing against a military figure. Providing a model attains sufficient marks

it will be awarded a Gold, Silver or Bronze Medal. There are also a number of Special awards and Cups which are awarded at the Judges' discretion.

## COMPETITION CLASSES

### Duke of Edinburgh Challenge Trophy

Any model which has won a Gold or Silver Medal at a previous M.E. Exhibition or one of the cups donated by the friends of the Exhibition is eligible to enter this section of the competition. No model is eligible to enter this section more than once.



*Even the experts in the S.M.&E.E. Workshop are not above getting a bit practical advice. Here we see Tommy Bartlett, a veteran member of the Society getting an insight into the use of a Taylor Hobson engraving machine. The demonstrator is Graham Stothard, another senior and well respected member of the Society.*



## Engineering Section

### Class

- A1 Hot Air Engines
- A2 General Engineering Models (including stationary and marine engines).
- A3 Internal Combustion engines.
- A4 Mechanically propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A6 Fairground models.
- A7 Gnat Power
- A8 General Engineering craftsmanship not classified in this section.

## Railway Section

### Class

- B1 Working steam locomotives 1in. scale and over.
- B2 Working steam locomotives under 1in. scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes intended for track duties. Scratch built model locomotives of any scale not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratch built model locomotives gauge 1in. (10mm scale) and under.
- B6 Kit built model locomotives gauge 1in. (10mm scale) and under.
- B7 Scratch built rolling stock, gauge 1in. (10mm scale) and under.
- B8 Kit built rolling stock, gauge 1in. (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1in. scale.
- B10 Passenger or goods rolling stock, under 1in. scale.
- B11 Railway buildings and lineside accessories to any recognised

- B12 model railway scale. Tramway vehicles.

### Notes:

- (a) Kit built: any model containing a preponderance of commercially produced parts.
- (b) Scratch built: wholly made by the entrant except wheels, gears, motor, engraved plates and small turnings, etc., not exceeding 5% of the whole.
- (c) Rolling Stock: where a rake is entered, competitors are asked to nominate one vehicle for judging purposes.

## Military Model Section

### Class

- E5 Engineered military models; cannons, guns, tanks, etc., built primarily from metal and wood and usually with the use of a lathe.

## General Modelling

### Class

- F1 Scenic Dioramas, architectural and representational models (not listed elsewhere).
- F2 General craftsmanship entries (not listed elsewhere).

## Model Horse Drawn Vehicles Section

### Class

- G1 Carriages and other sprung vehicles. (Omnibuses, trade vans, etc.).
- G2 Wagons, carts and farm implements.
- G3 Caravans.

## Junior Section

### Class

- J1 For any type of model, mechanical or engineering work by an under 14 year old.
- J2 For any type of model, mechanical or engineering work by an under 16 year old.
- J3 For any type of model, mechanical or engineering work by an under 18 year old.

### N.B..

The Micro Steam Car Challenge is an event within the Exhibition, run under its own rules. Details of the building of the Basic Micro Steam Car were given in M.E. for 19 May 1995 and enquirers from last year's exhibition should by now have received reprints of this article.



## QUICK TIP

### Tapping through holes

If you need to buy a new tap to tap through holes, try to get the spiral point type. They push the swarf out through the hole.

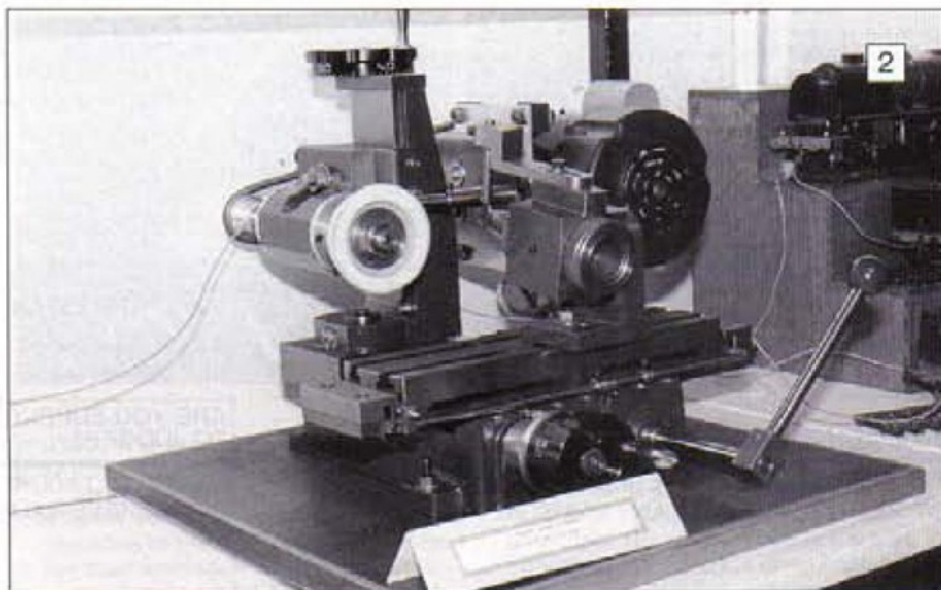
D N Crossley

## QUICK TIP

### Marking through

To mark accurately through holes for drilling, a piece of wood dowel which fits the hole can be fitted with a sharp point (a needle), which will scribe the outline of the hole.

Alan Jeeves



Typical of the tooling shown at the M.E. Exhibition, a well engineered version of the Stent Tool and cutter Grinder - seen on a club stand at last year's exhibition.



THE 65th  
**model**  
**ENGINEER EXHIBITION**

*at The International Model Show*

OLYMPIA 30 DECEMBER - 6 JANUARY 1996

GRAND HALL OLYMPIA, HAMMERSMITH ROAD, KENSINGTON, LONDON W14 8UX

30th DECEMBER 1995 - 6th JANUARY 1996

# COMPETITION ENTRY FORM

A separate form is required for each entry. Please send your entry form to:

NEXUS SPECIAL INTERESTS, NEXUS HOUSE, BOUNDARY WAY,  
HEMEL HEMPSTEAD, HERTS. HP2 7ST Tel: (01442) 66551

CLOSING DATE: FRIDAY 8th DECEMBER 1995

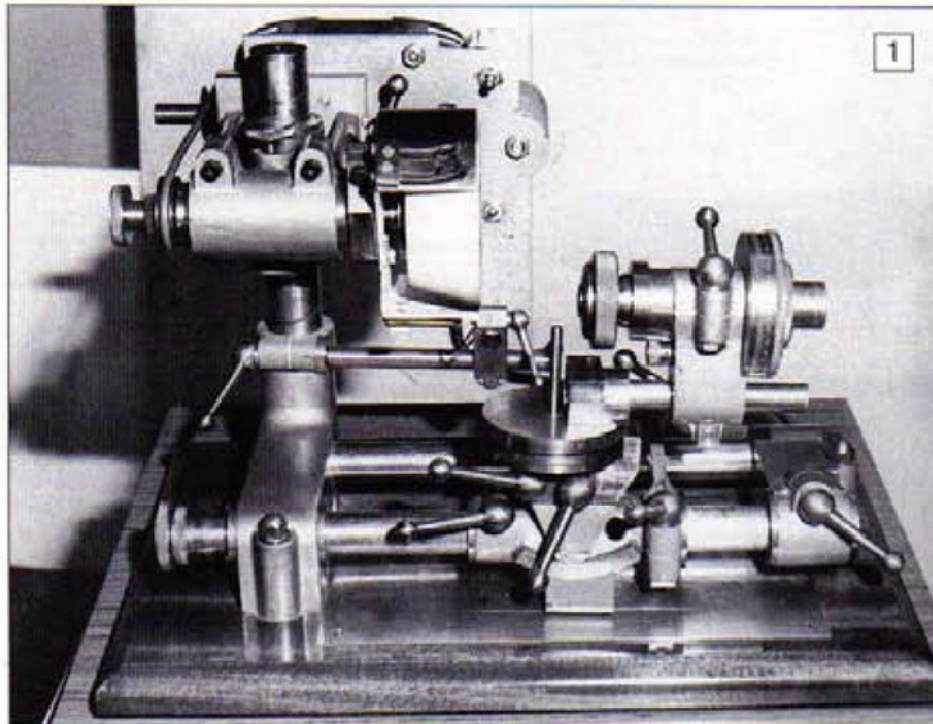
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| COLLECTION<br>SERVICE ROUTE | COMPETITION<br>REF. NO |
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|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| CHRISTIAN NAME(S) _____ SURNAME _____                                                       |                                                                                                                                               |
| ADDRESS _____<br>_____                                                                      |                                                                                                                                               |
| POST CODE _____ TELEPHONE NO _____                                                          |                                                                                                                                               |
| AGE ON 31st DECEMBER 1995.....yrs.....months                                                | HOW MANY YEARS HAVE YOU BEEN A MODELLER?.....                                                                                                 |
| TRADE OR PROFESSION/RETIRED                                                                 | CLUB                                                                                                                                          |
| TITLE OR DESCRIPTION OF MODEL                                                               | ENTRY CLASS                                                                                                                                   |
|                                                                                             | SCALE (IF APPLICABLE)                                                                                                                         |
|                                                                                             | VALUE OF MODEL £ .....                                                                                                                        |
|                                                                                             | HAVE YOU ENTERED THE COMPETITION BEFORE YES/NO                                                                                                |
|                                                                                             | KIT NAME (IF MADE FROM A COMMERCIAL KIT)                                                                                                      |
|                                                                                             | GNAT POWER-DO YOU HAVE ANY OBJECTIONS TO HAVING THE ENGINE RUN DURING THE EXHIBITION YES/NO                                                   |
| LENGTH _____ WIDTH _____ HEIGHT _____                                                       | PARTICULARS OF ANY PARTS OF THE MODEL WHICH ARE NOT THE COMPETITOR'S OWN WORK, AND DETAILS OF SUPPLIER (eg TRANSFERS, BOILERS, INJECTORS ETC) |
| HAVE YOU ENTERED THIS MODEL BEFORE? YES/NO                                                  |                                                                                                                                               |
| POWER UNIT (IF ANY) .....                                                                   |                                                                                                                                               |
| WEIGHT .....                                                                                | WORKSHOP FACILITIES USED ON THIS MODEL-STATE MAKE AND TYPE OF ANY MACHINERY USED.                                                             |
| ORIGIN OF DESIGN:<br>OWN DESIGN .....                                                       |                                                                                                                                               |
| OTHER .....                                                                                 |                                                                                                                                               |
| NEXUS. PLAN/DRAWING                                                                         | ARE YOU SUPPLYING NOTES TO JUDGES? YES/NO                                                                                                     |
| DETAILS OF GENERAL INTEREST FOR PUBLICITY (HOW MODEL WAS MADE ANY UNUSUAL FEATURES ETC.)    | NAMES AND ADDRESSES OF LOCAL NEWSPAPERS, JUNIORS PLEASE GIVE NAME AND ADDRESS OF SCHOOL                                                       |
| IS THIS MODEL YOUR OWN BONAFIDE WORK AND PROPERTY YES/NO                                    | WOULD YOU OBJECT TO YOUR EXHIBIT BEING MOVED FROM DISPLAY FOR PHOTOGRAPHIC PURPOSES YES/NO                                                    |
| IS A PHOTOGRAPH ENCLOSED? (THIS HELPS WITH ADVANCE PUBLICITY AND IN ASSESSING ENTRY) YES/NO | DO YOU OBJECT TO US GIVING THE ABOVE INFORMATION TO THE PRESS YES/NO                                                                          |
| MY MODEL WILL REACH THE EXHIBITION BY (Please tick appropriate box)                         |                                                                                                                                               |
| COLLECTION SERVICE                                                                          | ROAD CARRIER                                                                                                                                  |
| POST                                                                                        | PERSONAL DELIVERY                                                                                                                             |
| I DECLARE THAT THE ABOVE PARTICULARS ARE TRUE AND CORRECT                                   |                                                                                                                                               |
| SIGNATURE _____ DATE .....                                                                  |                                                                                                                                               |



# ANOTHER QUORN, A SCORE OF YEARS OR MORE ON



Do you have a set of castings for the Quorn Tool and Cutter Grinder tucked away in the cupboard? If so, It doesn't seem that you're alone. Here Theo Gooden of Durban, South Africa provides some tips as to how to complete the machine.

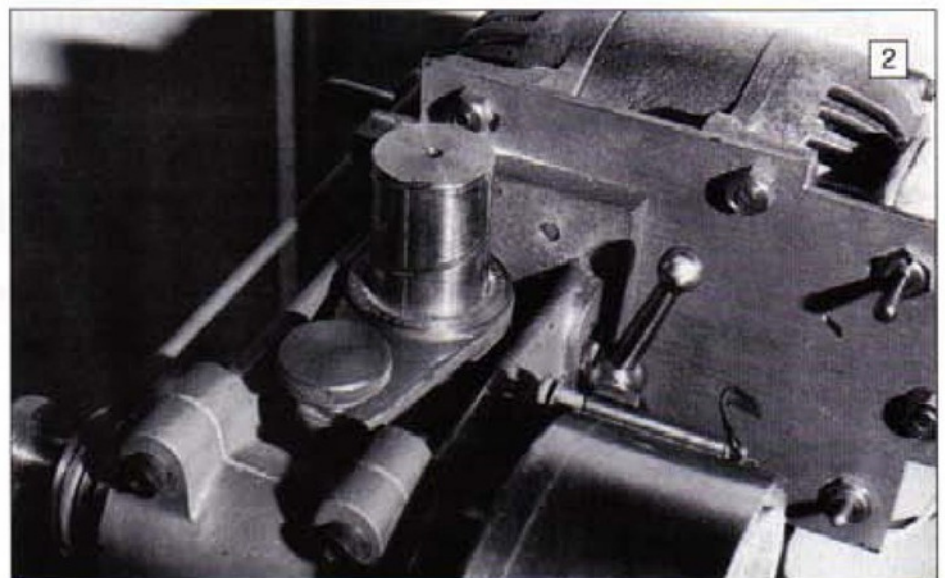
*1: The completed Quorn. Acorn nuts were used on the holding down bolts and a 20swg stainless steel plate on the base board prevents indentations from the ball handles, as the work head is inclined to tip forward unexpectedly.*

*2: This clearly shows the upper brass ring and the vertical line on the column. The upper end of the second vertical line may be just visible at 45deg.*

**A**n article on page 30 of *M.E.W.* No. 25 states:- "I have been worried about the problems of sharpening milling cutters for many years and have had a set of castings for the Quorn for over 20 years, but have never managed to get around to its construction". This prompted me to write this article, for I too had castings for about 20 years before getting on with the job. The interest was ever present and the interval gave me ample time to consider the task, and collect suggestions and comments from subsequent copies of *M.E.*

The opportunity came after my retirement, some 8 years ago, and the work proceeded with, generally in accordance with the instructions in *M.E.* (Prof. D.H. Chaddock's book was purchased later). Due to Durban's humidity and reputation for rust, I chose stainless steel for the ways and the column. Having an old Pittler lathe that could be driven by a sprocket on the end of the lead screw, through a worm and wheel motor driven arrangement, I elected to go for the spiral column. However, a  $\frac{3}{32}$ in. HSS. endmill objected to the stainless steel, so a  $\frac{1}{8}$ in. tungsten carbide cutter was purchased and this solved the problem.

The castings, which I believe came from Zambia, machined quite well, but gave evidence that the foundry had some connection with a cheese factory! 'Scols' iron cement and 'SmoothOn' having long since vanished from the



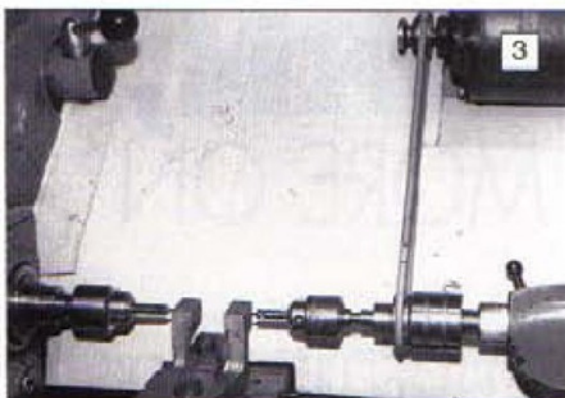
market, I was able to purchase some grey iron powder filled epoxy. This held the holes together admirably and machined well.

Because of the numerous blow holes in the base casting, it was not possible to engrave the calibrations directly on to this, the solution being to do the engraving on a circle of 20swg MS of the correct radius and approximately  $\frac{3}{16}$ in. wide. This was then located in the correct position and pinned on. In fact this method was adopted for all the flat

calibrated parts, including two additional rings of brass.

A modification was mentioned in Professor Chaddock's book, but was amended. The original instructions as published in *M.E.* gave no quick facility for ensuring that the wheelhead could be re-set to 90deg. to the ways without resorting to a DTI, or for setting the wheelhead to a specific angle. The book description of machine Mk II mentioned how this could be overcome by engraving an arrow top and bottom of





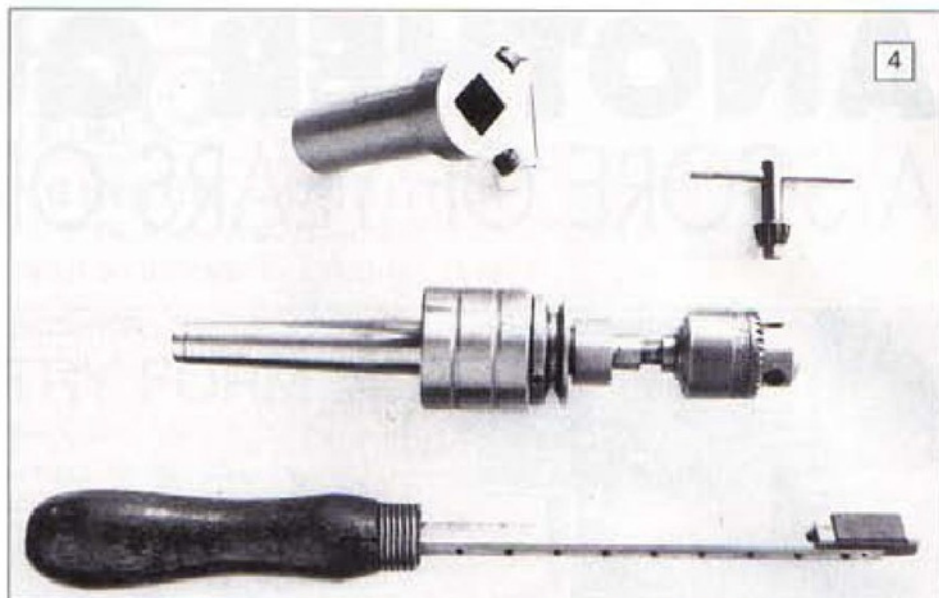
the casting and fitting an additional calibrated index ring, which had to be keyed (very accurately) to an additional groove or keyway in the column. It was felt that it would be difficult to align the arrow with the engraved ring and with the key or peg engaging a keyway that traversed several milled radial grooves, smooth action and accuracy would be at risk.

An alternative method of registering the workhead was by engraving two straight vertical lines exactly at 45deg. to each other on the column. When bonding the column into the base using structural adhesive, one groove was set exactly at 90deg. to the ways and forward facing, the other groove directly in line with the ways and inward facing. The reason for the second groove was that, in the event of the height setting of the workhead registering with a spiral groove (which would present a gap), registration would then be picked up from the second groove. Two brass rings, about 20swg, with a bore dia. to just clear the column and of an OD equal to the diameter of the workhead sleeve, were turned up and calibrated 0-40-0-40 and bonded, one each to the top and bottom of the sleeve. Although the divisions on these rings are very fine, they can very easily be picked up with a magnifying glass (this device is a constant companion to the machine).

Another helpful device when using the machine is a 6in. length of  $\frac{1}{2}$ in. bore copper tubing. This slips over the ball handles, does not mark them and gives that extra nip on the handles, thus preventing any movement to the locked parts just when you don't want it.

Those who have yet to build the machine and have a wish to ensure that the pivot sockets on the wheel collar bracket are exactly opposite and in the correct location can do this by making a belt driven tailstock drilling assembly (2 MT for the Super 7), fitted with a rotatable chuck and driven by a separate motor. This is not an original device; I first came across it in *M.E.* Vol. 109, No. 2733 of 1953, page 441. For those who would like to construct a similar one, details are as follows:

A mild steel sleeve  $1\frac{3}{4}$ in. long x  $1\frac{1}{2}$ in. OD is turned on a 5in. length of  $1\frac{3}{4}$ in. stock. The sleeve is bored  $1\frac{3}{4}$ x  $\frac{7}{8}$ in. deep to accommodate a pair of radial thrust bearings. (I used two NSK 6202Z -  $1\frac{3}{4}$ in. OD x  $\frac{7}{8}$ in. ID x  $\frac{3}{4}$ in. wide). The back end of the stock is turned 2 MT, approx.  $3\frac{1}{4}$ in. long, with a  $\frac{1}{4}$ in. end



section  $\frac{1}{2}$ in. dia. and parallel. A piece of 1in. mild steel is reduced to  $\frac{7}{8}$ in. OD. for  $\frac{1}{2}$ in. and of the remaining  $1\frac{1}{4}$ in., a  $\frac{7}{8}$ in. wide section is turned down to  $\frac{7}{8}$ in. (to fit the Vee pulley) and the remainder turned to a neat fit in the two bearings. Make sure that there is a small boss on the inner face of the pulley, so that it does not foul the bearing housing. The bore of this assembly is bored 0MT or anything suitable for whatever  $\frac{1}{4}$  in. chuck is available.

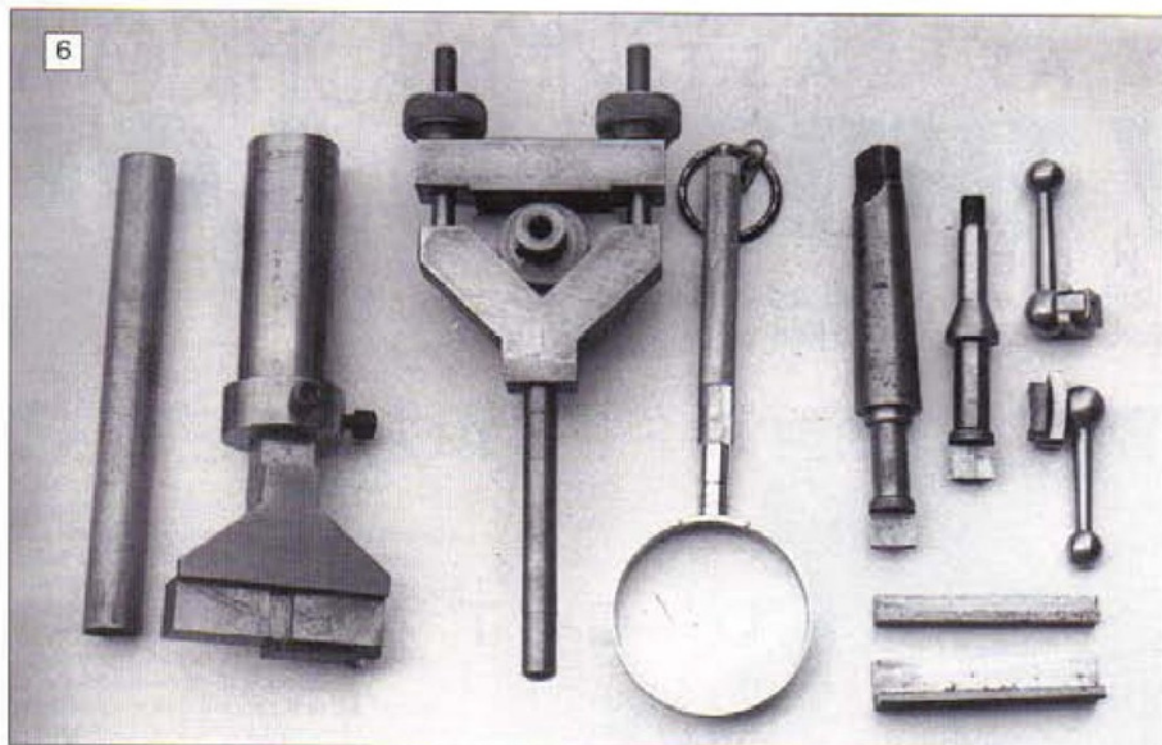
In use the tailstock drilling assembly is driven by a small motor suitably located. With a  $\frac{1}{4}$ in. Slocombe drill gripped in the chuck, the wheel collar

**3: The set-up for drilling from both the head and tail-stock, with the work on the cross slide, thus ensuring hole alignment (providing that the lathe alignment has been established as being correct).**

**4: The filing device for dealing with the square hole, the tailstock drill assembly and the completed arbor with the square hole.**

**5: Accessories for the Quorn, including a selection of wheels, each mounted on a separate arbor, and a couple of arbors in the making.**





6: A further selection of accessories, including setting arbors and ball handle dovetail stops for the workhead.

bracket is mounted on the cross slide and clamped, after being packed up for centre height and alignment. The opposite hole is made by fitting the Slocombe drill in a chuck mounted in the headstock mandrel. After drilling the one hole it is just a matter of moving the saddle along for the other and making sure that the depth is more or less uniform. This same arrangement is then used for drilling the two  $\frac{1}{16}$ in. tapped holes in the wheel head bracket.

Unfortunately my kit did not include the forged steel casting for the rotating base, and this had to be fabricated. However, Professor Chaddock's alternative method in *M.E.* Vol. 157, No. 3784 (5 Sept. 1986, page 272) was adopted, as was Mr L Ridger's method of forming the radial groove (*M.E.* Vol. 159, page 610), which was based on George Thomas's dovetail groove for his Rotary Table in *M.E.* Vol. 142, No. 3550. This whole assembly came together without any problems and the alternative methods proved to be well worth incorporating. Yet another simple time saver was in regard to making the pivot bolts, thus avoiding producing spacer washers of varying thicknesses (to say nothing of avoiding more swarf). These were made from  $\frac{1}{16}$ in. dia. MS Rod, threaded  $\frac{1}{16}$ in. BSF for the ball handles and  $\frac{1}{16}$ in. BSF (or BSW) at the other end, after determining the appropriate length;  $\frac{1}{16}$ in. square nuts screwed home and chemically bonded at this end. The flats on the lands where they fitted had to be widened slightly to accommodate the square. A register mark was made on one edge only, thus giving four positions for the locking of the ball handle, and so ensuring that this was achieved without fouling some part of the machine.

Other than the failure of the  $\frac{1}{16}$ in. HSS end mill on the stainless steel when grooving the column, the first real

problem was attempting to make the ball handles by the form tool method and using so called free cutting MS. All went well until the final cut was being made, the tool dug in and the ball ended up in the drip tray. This happened all too frequently, so after a trial of patience, frequent honing, copious coolant, doubts about the free cutting and some nasty language, the job was put on hold for a year or so because of back trouble. However, the months in bed gave ample time for reading *M.E.s* (and many other books) and thinking. The final decision was to forget about form tools, annealing steel balls etc., and a simple ball turning tool was made (one of many detailed in *M.E.*). The use of this, together with Mr George Thomas's advice and jigs etc., meant that making ball handles became a pleasure (even with so-called free cutting MS). The machine has now been completed and the art of using it is being studied. For certain applications, additional arbors and spacing devices have become necessary.

There was however one final challenge! The  $\frac{1}{16}$ in. square hole in the tool holder. I elected to make the solid one with the square right through the full  $3\frac{1}{16}$ in. length. The several ways described of making this were ruled out, as it was thought the square could be filed much quicker than the tools, jigs, milling and brazing and so on, would take to manufacture.

After machining the  $1\frac{1}{16}$ in. bar to 1in. dia., less the  $\frac{1}{16}$ in. collar for housing the 2 BA grub screws, a  $\frac{1}{16}$ in. hole was drilled right through and provided four registration points for forming the flats.

A gauge, exactly  $\frac{1}{16}$ in. square x  $\frac{3}{16}$ in. thick, with a 90deg. corner was filed up and screwed to an 8in. length of  $\frac{1}{16}$ in. rod, thus forming a 'go' gauge. The four corners were carefully located in the hole and some effort was expended,

firstly with an 8 x  $\frac{1}{16}$ in. pillar file, and as soon as it would pass right through the hole, a  $\frac{1}{16}$ in. square file. Care was necessary to avoid forming a bell mouth at the ends; the gauge was helpful for this, as it was for removing the inevitable centre hump.

This hump or bulge was removed with a tool made using a short piece of a flat cut 'O' file, about 1in. long x  $\frac{1}{16}$ in. wide, dovetailed into a handle about 8in. long of  $\frac{1}{16}$ in. x  $\frac{3}{16}$ in. MS. The short length of file was a press fit in the dovetail. This device could be introduced into the hole from either end, and worked on all four flats wherever there was a high spot which was soon picked up by the gauge. I must confess my own astonishment as to how well this worked and how quickly it was able to clear the centre, so that the gauge could pass right through.



## QUICK TIP

### Tapping in the lathe

A spiral flute tap will also help when tapping through holes in the lathe. They bring the swarf out of the hole, rather than pushing it through into the chuck or mandrel.



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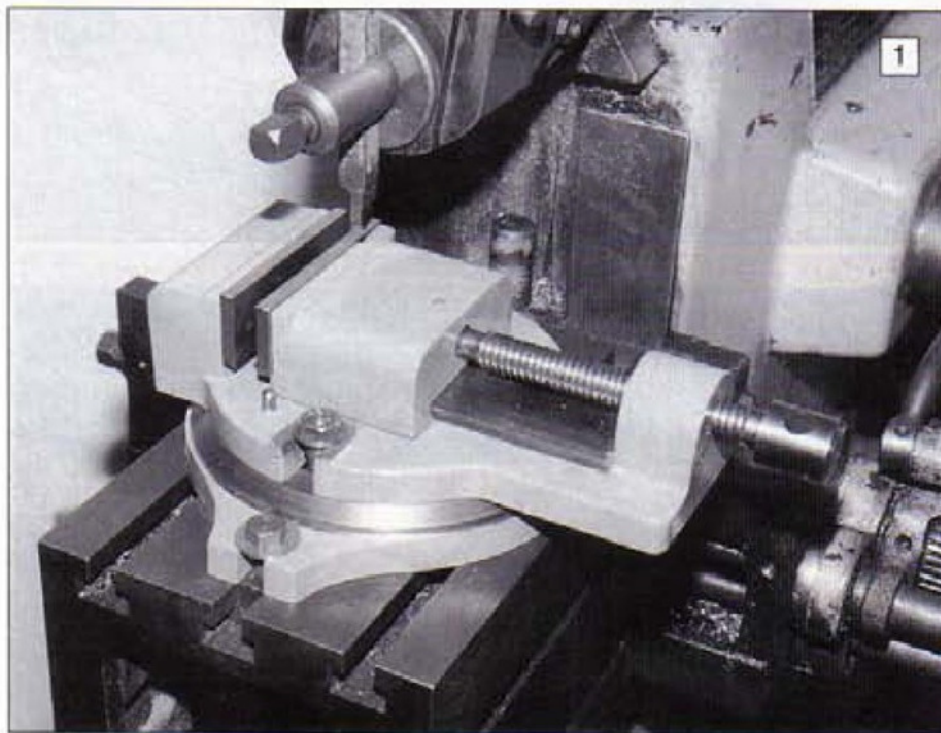


# MODIFICATIONS TO A MACHINE VICE

John Brittain describes how he added a swivel base to the vice fitted to his shaper and adds some tips on chain drilling

**S**ome time ago I acquired a plain machine vice, which served me quite well over a period as the means of holding work on my shaper. However, from time to time I found myself transferring the swivel-base vice from my miller to the shaper, in order to perform setting up operations more easily, and began to wish that the plain vice possessed a rotating facility. Toying with the idea still further, I examined the plain one, with a view to its possible modification, and decided that the task of converting it to a rotary type was indeed feasible. The following is an account of how it was done.

Since I possessed neither a vertical miller nor a rotary table, my design would necessarily preclude the usual means of holding the two halves of the vice together, i.e. a circular tee slot in which two bolts are constrained to move so as to allow for a full 360deg. rotation. I therefore opted for an alternative solution which, though restricting the vice to a 90 degree rotational movement, would, I thought, satisfy my particular requirements. Drawing a full-sized vertical section and plan (see Fig. 1) convinced me that the job was a 'goer' and I therefore looked around for a suitable piece of hardwood from which to make a pattern for the swivel base. I unearthed a sample of adequate thickness and, cutting it into three, glued the pieces together as shown in **Photo 1**. My wood turning lathe exists in embryonic form only (pending the extension of my workshop), so I was forced to use my Harrison L5 for the job, but the task proved very straightforward and the pattern was completed without difficulty. (**Photos 2 & 3**). A local foundry undertook to cast the



base for me and, while waiting for this to be done, I occupied myself with the task of machining a 'register' recess in the underside of the vice; in order to accomplish this I needed first to remove the 'gap' piece from the lathe bed. Lucky me. By so doing, the job just cleared, as indeed did the counterbalance weight which I provided and which is shown in **Photo 4**. While the vice was set up in this way, I skimmed its base for good measure.

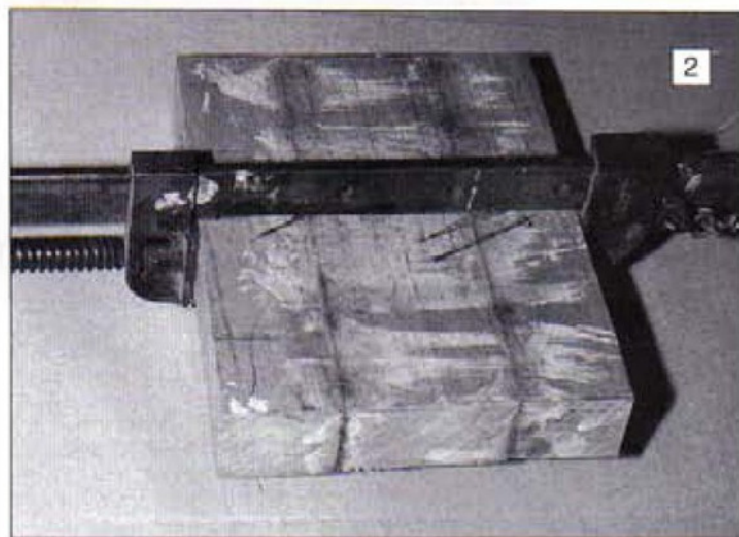
Meantime I was able to collect the base casting and contemplate the best way of machining it.

Since I should need to fasten it to the faceplate, the first task was to drill two holes at a position where the semicircular ended slots in the lugs would be formed. This done, the job was set up in the four-jaw chuck and the base surface plus the recess machined as shown in **Photo 5**. Replacing the four-jaw with the faceplate, I fixed the casting as shown in **Photo 6**, interposing a piece of newspaper between the two surfaces to avoid any possibility of the job moving while being worked on. As the photograph shows, machining was perfectly straightforward, the only aspect needing special care being the fitting of the register with its corresponding recess in the vice base.

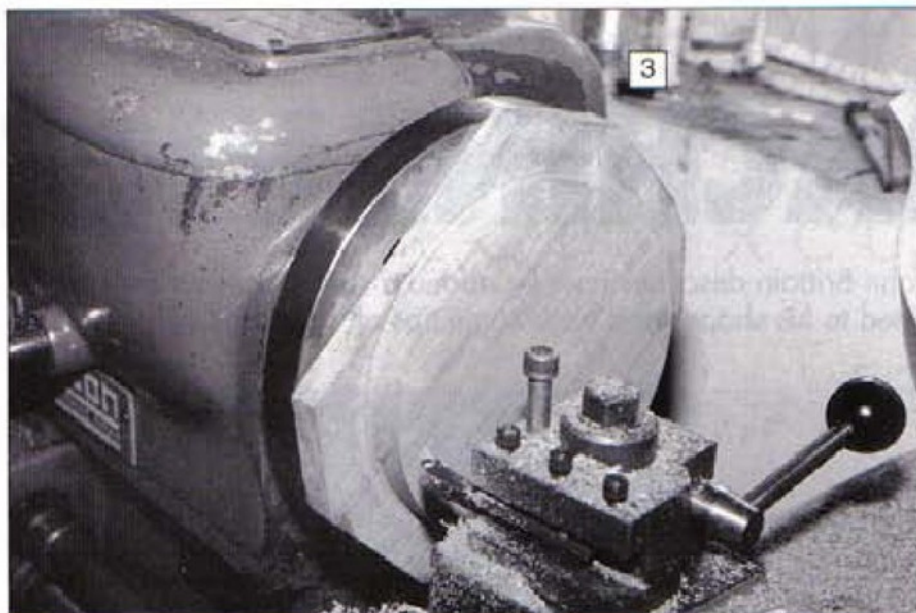
The next process was to form the curved slots and since, as mentioned earlier, no vertical miller graced my workshop, fashioning them by hand seemed the only option. Accordingly I proceeded by marking out first the centre lines, then the semicircular ends and finally the inside and outside curves.

## Chain drilling — the easy way

At this point, a word to the less experienced reader might be considered

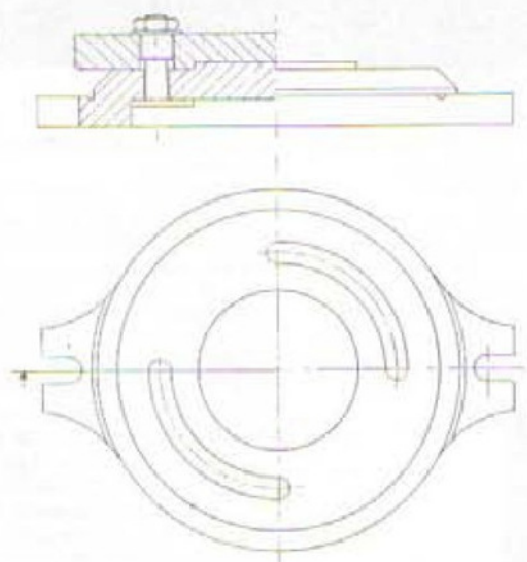






## DETAIL OF VICE BASE

Detail of vice base



**Fig 1**

appropriate. When chain drilling prior to forming a slot by hand, beginners tend to centre punch along the centre line at guessed positions and, having drilled a row of holes, discover that they are left with a dog's dinner of a filing job, with some holes having broken into one another horribly but with others miles apart. My advice is don't! You will save far more time and effort if you approach the task in a methodical manner and, I would suggest, gain a great deal more satisfaction from using a more orderly approach. I recommend the following procedure as being straightforward, efficient and guaranteed to give consistently good results.

Having marked out the slot, select a drill size which is somewhat smaller than the slot width (say  $\frac{1}{32}$  in.) and set a pair of dividers to a smidgen less than this. Beginning from the centre of one of the semicircles, commence to mark off this distance along the centre line until you reach the other end. (see **Fig. 2 (1)**) Yes, I know. Of course the Law of Cussedness insists that the divider setting is never a sub-multiple of the total length, but no matter. Ignore the last mark (or two) for the moment and centre punch the remaining positions. Now select a suitably sized pilot drill and proceed to drill every punched position, (**Fig. 2 (2)**) including both ends, and you are ready for the most entertaining part of the job. Return to the original drill size from which the divider setting was derived and proceed to drill every other hole, (**Fig. 2 (3)**) after which you can complete the 'chain' by drilling the remaining holes. (**Fig. 2 (4)**) It is a delight to watch each hole breaking into its adjacent ones, knowing that, by so doing, much filing has been saved. The great advantage of overlapping holes is that it is possible to insert a file into the gap thus formed and so make the commencement of filing very much easier. Of course, an even number of holes doesn't work out as conveniently as an odd number, because obviously, with the former, you will finish up trying to drill a hole which is breaking into another one on one side but not on the other, and this approach inevitably results in the drill wandering straight into the



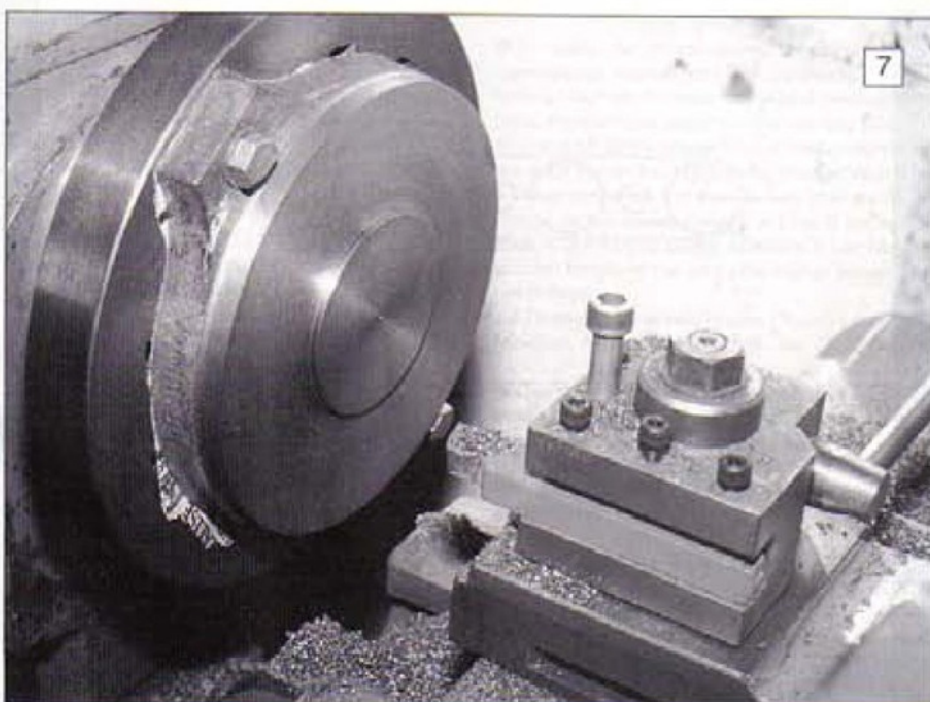
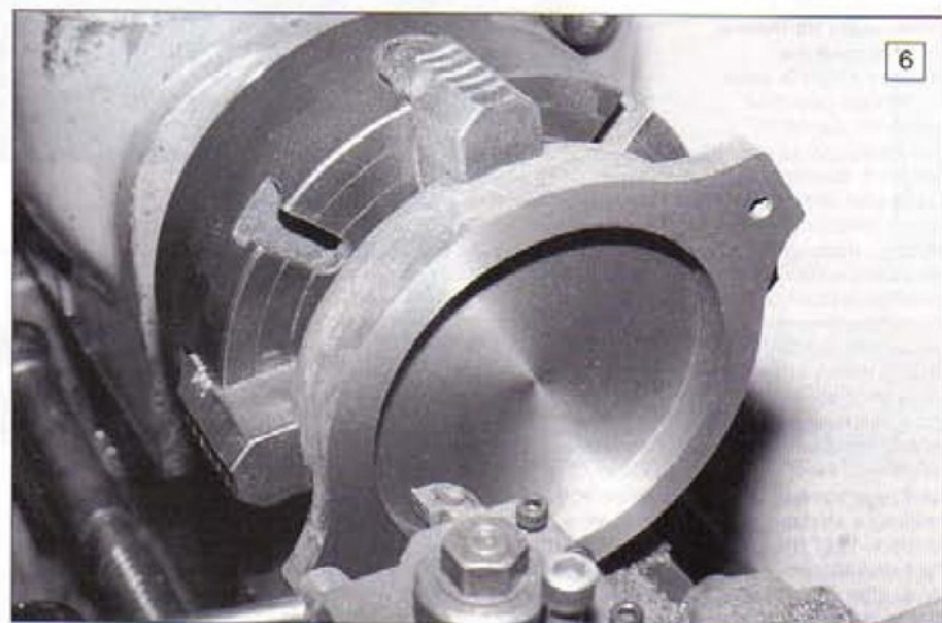
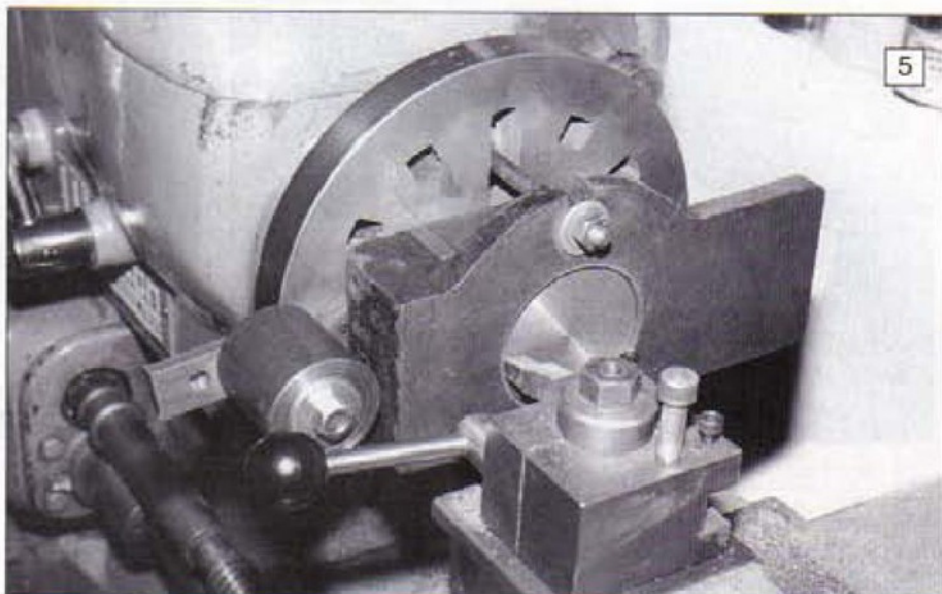
broken-into hole — if you see what I mean. But you must use your discretion, as indeed you must do with regard to the uneven spacing at the end. Shifting the centre over (**Fig. 2. (4a)**) is a good plan here, after which you can halve the distance between the last two holes and switch to a smaller drill. The point is that you will finish up, in the main, with the happy situation as depicted in **Photo 7** (far side row of holes) and thus be able to break into each successive hole with a file using the minimum amount of puff. If you have never tried this method of chain drilling before, I suggest that you have a go. You will not be disappointed! By the way, when a semicircular ended slot is formed by hand methods, some people may prefer to shape the ends immediately by drilling the end holes to the correct size, in which case this must obviously be done at stage 3.

### Another way round the problem

As mentioned earlier, I had resigned myself to the notion of finishing these slots off by hand and was in the very act of doing just this when the circular table of my drilling machine happened to catch my eye. "With very little waste material to be removed, why not centre the job on the table and feed it round by hand, using a rotary file in the chuck?" I mused. Since the spigot of the table was a stiff fit in its housing, I anticipated no trouble in the way of snatching, and this proved to be the case; the final finish was excellent even if the slot width was a little larger than planned - 10 mm rather than 9.525mm ( $\frac{3}{8}$ in.). See **Photo 8**.

### Securing bolts

Turning a pair of bolts with which to hold the two halves of the job together was, of course, a simple matter; having done so, all I needed to do was to file a flat (arc) on each the bolt heads so as to

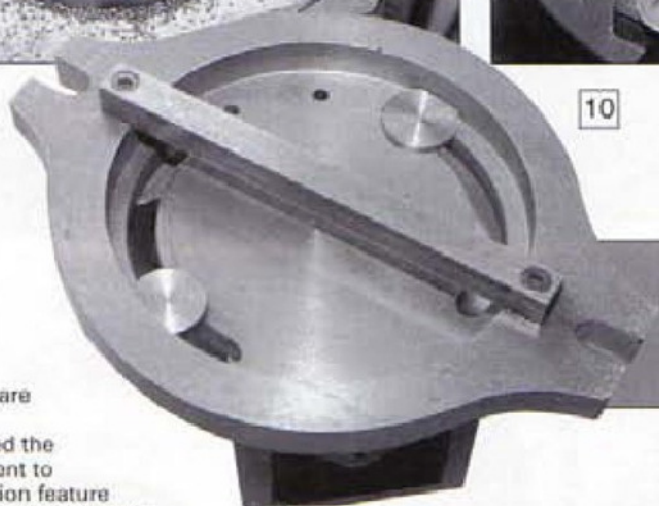


allow them drop into the base recess and slide round their respective slots easily without allowing them to turn (**Photo. 9**). The lug slots in the vice base were somewhat larger than the bolts, so, in order to prevent any possibility of jamming, I provided flanged collars, which fit snugly inside the lugs and also act as washers for the nuts.

### Graduate or drop-out?

During the initial planning of the job, I had intended graduating the base with the usual degree intervals, but the nearer the task loomed the more I questioned the need for this particular facility. I know that when constructing workshop equipment of this type (i.e. that which possesses rotative movement) most model engineers would automatically think of providing a means of setting angular measurement but, having done so, how often is it actually used? I pondered this for some

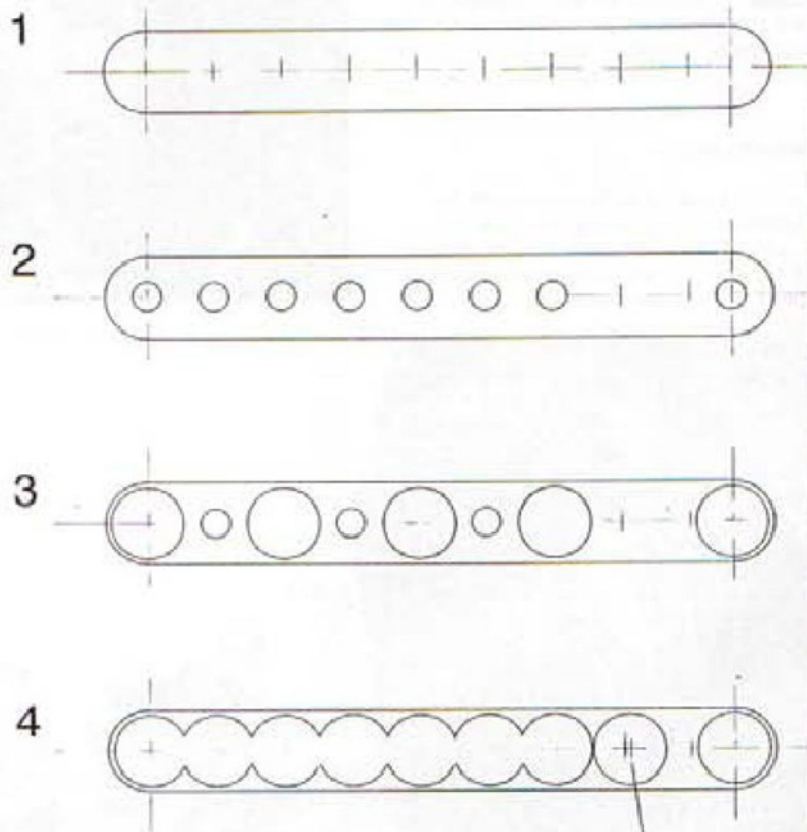




time and concluded - "very rarely in most cases". Almost invariably when the task does arise, a more accurate means of obtaining the desired angle is used and those beautiful graduations, so painstakingly engraved, are ignored. Besides, my particular design confined the vice's rotational movement to 90deg., making the division feature even more redundant. No, what I really needed was a quick and accurate method of setting the vice jaws both parallel and square to the line of cut. Therefore, with this in mind, I decided first to provide a means of accurately locating the vice base on the shaping machine. This I did by obtaining a piece of ground square-sectioned steel which was a close fit in the centre groove of the shaper table and, after milling a shallow groove to receive it in the underside of the base, fixed it by means of two cap screws. I then assembled the vice and, after bolting it to the shaper table, set the vice jaws parallel with the direction of cut by fixing a dial test indicator in the toolpost of the ram. After tightening the slot bolts, I removed the complete vice from the shaper and transferred it to the drilling machine, where I drilled a  $\frac{1}{8}$ in. hole through both castings. This hole was then opened out with a taper pin reamer and a silver steel taper pin made and fitted. The same procedure was repeated with the vice swivelled through 90deg. and again, after setting the jaws accurately, another tapered hole provided for this position. Finally, I milled a  $\frac{1}{8}$ in. groove each side of the taper pin head and slotted a piece of  $\frac{1}{2}$  x  $\frac{1}{8}$ in. bright drawn steel to provide a spanner with which to remove the pin. Having used the vice in its modified form for quite a while now, I find that its most useful additional asset is the ability to set the jaws quickly by the above means and, though I anticipate causing a furore amongst certain members of our fraternity with my statement concerning the suggested redundancy of base graduations, I am nevertheless sticking to my guns. I may not be able to set-up 73deg. (approximately) as speedily as some folk but I sure can obtain a parallel or square setting quickly - and accurately!



## METHOD OF CHAIN DRILLING



a  
**Fig 2**



# A SUGGESTED MODIFICATION TO THE MYFORD SLOTTER

In our last issue we published a design for a slotting attachment for the Series Seven lathe. Its designer, Pat Twist has come up with a small modification which will increase the capability of the unit.

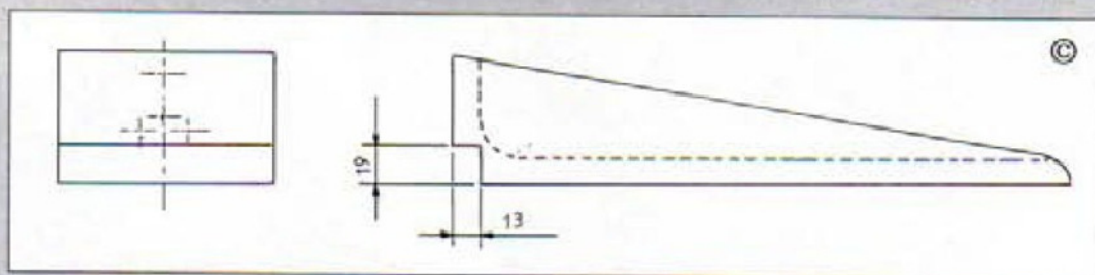
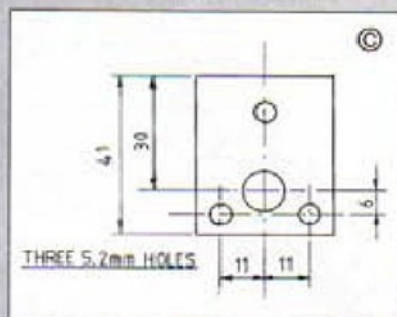
Experience of using the device has led me to believe that its usefulness could be increased if the main support angle were cut away at the base to allow the apron at the leading edge of the lathe saddle (the part where the travelling steady bolts on) to pass underneath. This will allow the tool to traverse further across the cross slide, thus increasing the capacity. This

modification (shown on the sketch) should not weaken the casting unduly, especially if arrangements can be made to modify the pattern to thicken up this area. The change will entail a modification to the location plate (Item 8), which will need to be shorter and secured in a slightly different manner.

## Casting availability

Castings for the Main Support Angle, Item 1, are available from:- The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton, WV8 1EJ.

Tel. or Fax: 01902 842284



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P. Spalding 25 Salterford Grove, Grantham, Lincs. NG31 7HP Tel. 01476 62256

• Handbook and Maintenance Manual for Churchill 6in. x 18in. Hydraulic Surface Grinder with Pneumostatic wheel head bearings (circa 1950s). For purchase or photocopying. All expenses willingly reimbursed.  
J.F.Bell, Setts Wood Farm, Appledore Road, Tenterden, Kent. TN30 7DG. Tel. 01580 766540

• I need a handbook, maintenance manual, lists etc. for the Elliott Model 10M Shaper. Photostats acceptable or will copy and return with reimbursement.  
I have a handbook for the Smart & Brown Model 'A' toolroom lathe, which I will photocopy if requested. I require a part of the handbook giving lubrication points and detailed maintenance instructions for this lathe.  
S.G.Walker, 168 Wallasey Road, Wallasey, Merseyside, L44 2AF Tel. 0151 639 4769

• For Colchester Bantam lathe, information on an economical conversion from flat belt to V drive. Also handbook/literature to copy and return. Costs gladly refunded.  
T.Kelly, 104 Minchery Road, Littlemore, Oxford, OX4 4LY

• I am restoring an 'Adept' 1 1/2in. lathe and have the original 4 jaw independent chuck, but cannot locate a 3 jaw S.C chuck. Does anyone know whether such a chuck was ever made for this lathe and, if so, where one might be found?  
R.Martin, 23 Birch Close, Send, Surrey. GU23 7BZ. Tel. 01483 222199

• To borrow for photocopying, the operating and maintenance manual for a BCA Jig Boring and Light Milling Machine. All expenses will be reimbursed. Does anyone have experience of running this machine off single phase? I have tried supplying the delta connected Higgs three phase motor from a phase converter, but there is very little starting torque. At the lowest speed it will run if the belt is spun to get it up to speed, but there is just not enough torque to run using the higher speeds on the pulleys.  
J.A.Robey, Matherfield House, Church Lane, Mayfield, Ashbourne. DE6 2JR. Tel. 01335 344472

• Can anyone provide information on a Carstews Milling Machine with an 11in. x 5in. table? I would be pleased to pay for a copy of a manual  
H.F.Gibson, 3 Kirkton Road, Westhill, Skene, Aberdeenshire. AB32 6LF Tel. 01224 744960 Fax. 01224 723191

• For Myford ML4, 3 1/2in. lathe, drawings or other information on how to replace/recondition the leadscrew nut assembly.  
B.J.Barnes, Riverside Cottage, Draethen, Newport, Gwent NP1 8UD

• For Harrison Vertical Milling Machine 30INT (30in. x 8in. table with power feeds and 8 speeds 80 to 2000rpm), any instruction or parts manuals or sales brochures or photocopies of same. Any expenses willingly reimbursed.

T.Craig, 75 Dunadry Road, Dunadry, Co. Antrim N. Ireland BT41 4QJ Tel. 018494 466634

• I need a 8in. or 10in. faceplate for my 5in. Atlas lathe; any secondhand one would do if it could be bored out to 1 1/2in. x 8 TPI. Also required, a reasonable small four jaw chuck. Buy or swap (I have a Myford swivelling vertical slide and a hydraulically clamped swivelling ball vice surplus to requirements).  
J.L.Hayward, Tel. 01604 582839

## FOR SALE

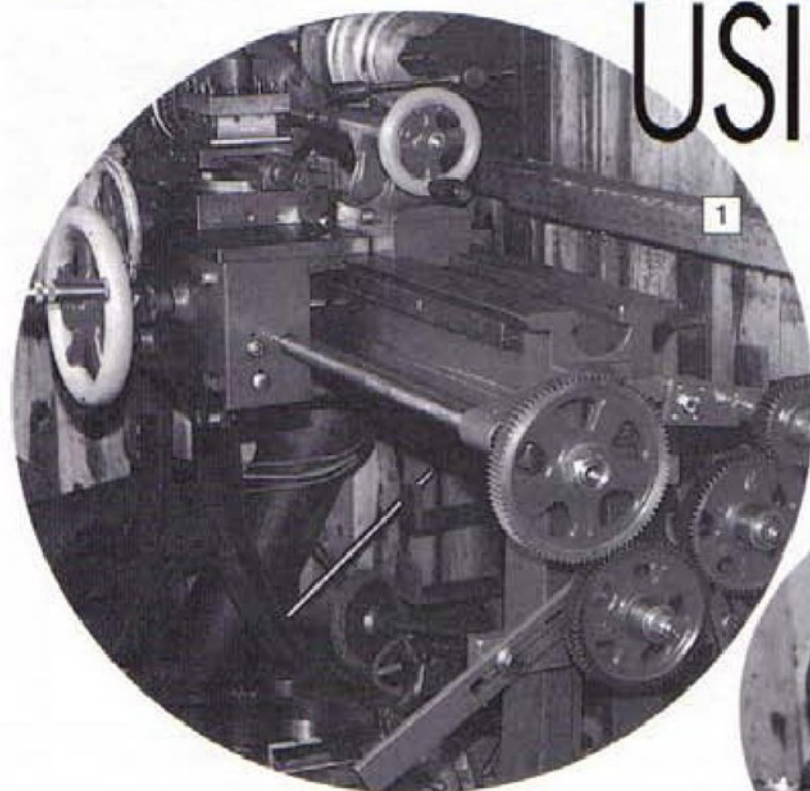
• Polishing/Lapping machine made by E.W.Jackson (Doncaster) Ltd. Horizontal disk type once used for polishing metallurgical samples. 3 speeds via cone pulleys, 1/4 HP single phase motor, Mop and holder missing, but 8in. dia. grinding wheel fitted. £15.00  
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Buyer to collect or I could deliver locally (Bradford) Tel. 01274 633579

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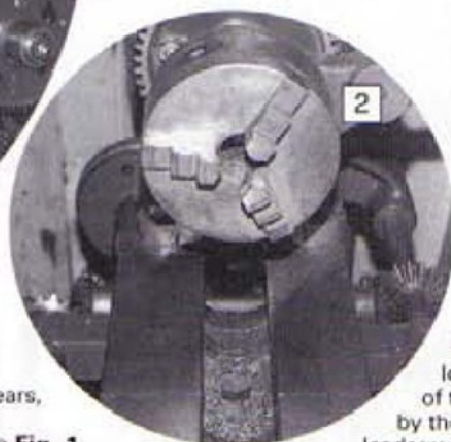


# TAPER TURNING USING GEARS



1

Alan Jeeves describes a method for turning tapers in which he uses the change wheels to set up the taper. Not many of our lathes will be equipped to carry out this process, but what are the prospects of devising a practical attachment?



2

1: The lathe ready to turn a Morse taper using a simple 4 wheel gear train.

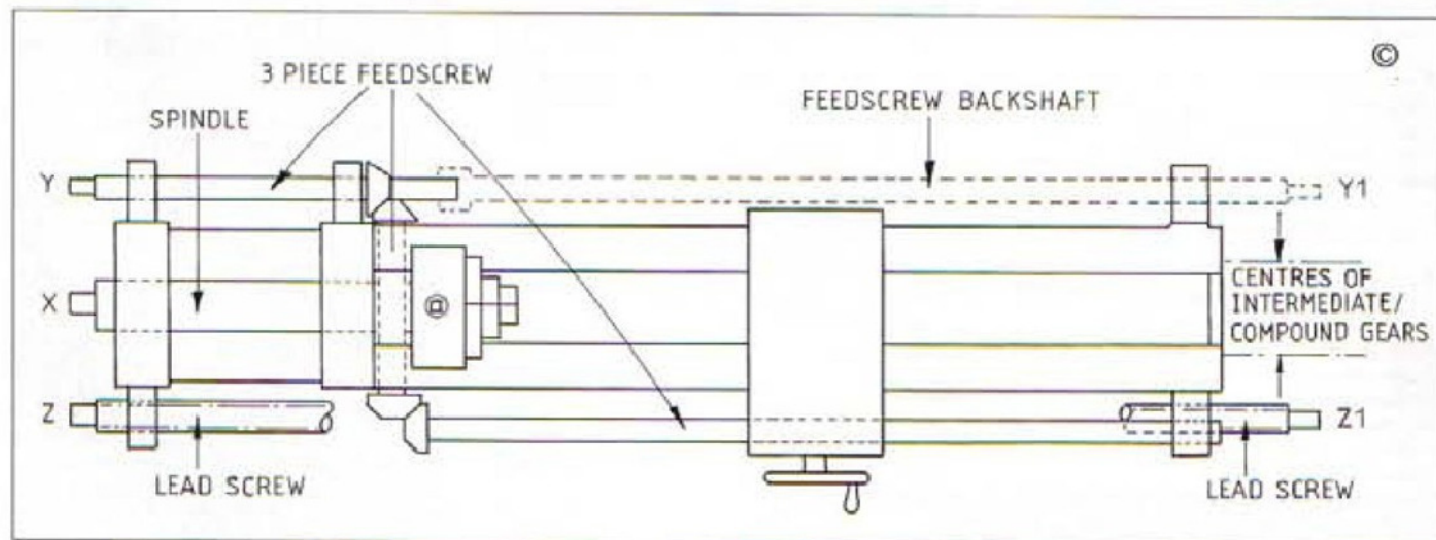
2: View showing the two feed screws (leadscrew hidden from view).

**S**liding, surfacing and screw cutting (ss&sc) centre lathes produced during the first third of the twentieth century were equipped with a very simple method of driving the leadscrew or the feedscrew at the desired speed, i.e. via a gear train driven by the spindle, and determining the ratio between the lead/feed screw. This ratio depends upon the careful calculation of the gear train. Some of these lathes were designed with the leadscrew at the front of the machine (as on modern lathes) but with the feedscrew starting at the back of the machine behind the headstock and diverting through 90 deg., by way of a pair of bevel gears, through the bed to the front of the lathe. It then made a second 90

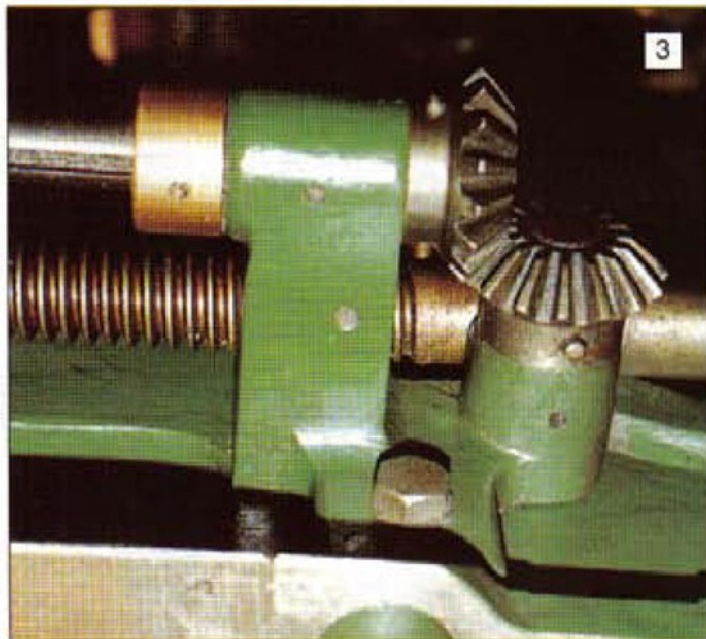
deg. turn, through a second pair of bevel gears, to run parallel with the leadscrew. Reference to Fig. 1, should make this clear.

It will be seen that if a gear train is used to connect the spindle, X to the feedscrew, Y, the feedscrew will revolve in relation to the spindle and can be utilised to traverse the saddle longitudinally along the bed or, alternatively, traverse the cross slide by means of the cross slide screw. It cannot, however, drive both the saddle and the cross slide simultaneously. The ratio of angular velocity (rpm) between the spindle and the feedscrew is thus determined by the gear train. The same applies if the spindle, X, is connected to the leadscrew,

Z, except that only the longitudinal movement of the saddle is possible by the rotation of the leadscrew. This, of course, is how screw threads are cut in the lathe, the thread pitch being determined by the gear train. These lathes then, would be supplied with a selection of gears or 'change wheels', which normally ranged from 20 teeth to 120 teeth in increments of 5 teeth. Included in this set of change wheels would be at least one duplicate wheel, usually 40 or 60 teeth, to enable a 1 to 1 ratio to be available. It may also be seen from Fig. 1, that, when a gear train is in use between X & Y, the leadscrew, Z, is allowed to 'freewheel'. If an extension is added to the first section of the feedscrew,





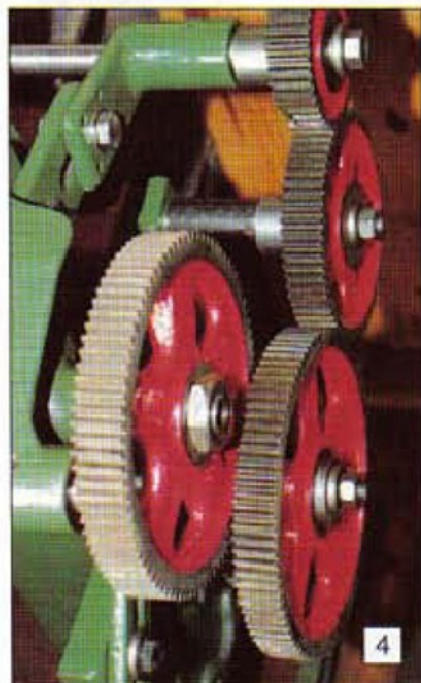


3

**3: The pair of bevel wheels at left on photo 2. (The lead screw can now be seen).**

**4: A single compound train. (5 wheels)**

**5: The tail of the lathe awaiting a set-up.**



4



5

to run the full length of the lathe at the back, and through a supporting bearing at the tail end, and this "backshaft" is connected to the lead screw through a second train of gears at this end (Y1 connected to Z1), then the feed screw can traverse the cross slide (with the surfacing lever engaged) and also drive the free wheeling lead screw (with the screw cutting lever engaged) to traverse the saddle. If the saddle can be traversed at the same time as the cross slide, then the cutting point in the tool post must travel diagonally. The amount the cross slide will travel will depend upon the careful calculation of the gear train between Y1 & Z1. A similar arrangement is used on certain dividing & indexing heads in the toolroom to cut a helix, perhaps on a twist drill being produced. One of the handwheels would be removed from the table on the milling machine and replaced with a gear. An extension is fitted to the dividing head spindle and another gear fitted to that, in alignment with the first. If

the ratio between these gears is, for example 40:1, and the pitch of the lead screw of the milling machine is, 0.125in., then, as the drill flute is being cut, for every 5in. in its length the drill blank will rotate one full revolution, producing a spiral or twist of 1: 5. To obtain different spiral ratios, different gear trains are used.

When setting up my gear trains I am indebted to R.J. Loader for his very useful Quick Tip (M.E.W. issue No. 10) of placing pieces of paper between the gear teeth to obtain clearance without excessive backlash.

When the feed screw is running "forwards", the cross slide, when engaged, will traverse towards the centre of the machine. When taper turning, the cross slide will normally be required to traverse from the centre outwards towards the operator as the saddle moves simultaneously towards the chuck. The feed screw will now have to be running "backwards". If the lead screw is connected to it by a 3-gear train at the tail end, the

lead screw will also be running backwards, causing the saddle to move away from the chuck. Therefore a 4-gear train is employed to drive the lead screw in its correct direction of rotation. The 4-gear train also allows the use of many more gear ratios. It is apparent that the faster the cross slide moves per revolution of the lead screw, the steeper the angle of cone will be generated. On one particular make of lathe, the cross slide pinion, which is driven by the worm on the feed screw, may be of a different number of teeth to that on another make. The pitch of the lead screw may also vary, as may the pitch of the cross slide screw. It may be the case that the feed screw worm is single or double start; there was little standardisation practised by the makers of these older machines, each incorporated his own ideas. Because of these differences between the mechanisms of different lathes, before any gear train can be calculated for taper turning, a "constant" will have to be arrived at, which is appropriate for the lathe being used.

#### Finding the constant for the lathe

As most of these old lathes were made with Imperial dimensions, the following calculations and examples are also in the Imperial system. I think that the majority of more modern lathes in use in home workshops are likely to be Imperial rather than metric. For this reason anyone wishing to adapt their machine for the purpose of taper turning using gears may appreciate my working in Imperial units.

Before calculations can be made, certain information about the lathe will have to be gathered. You need to know the following:-

- the number of teeth on the pinion on the cross slide screw.
- the number of thread helixes on the feed screw worm. (1 or 2 start).

S = the pitch of the cross slide screw.  
P = the pitch of the lead screw.

These values will be particular to each individual lathe and for the purpose of illustrating the method of calculating gear trains, I use my own lathe as an example.

On my lathe the value of

A = 20 (teeth)

B = 1 (start)

S = 0.250in. (4 TPI)

P = 0.250in. (4 TPI)

A further value, D, is also needed. This is the distance of travel of the cross slide to equal 1in. on diameter of work. D, therefore, will always equal 1/2in. From all this data we can find the constant for our particular lathe, which is the number of revolutions of the feed screw to move the cross slide 1/2in. and will be the basis for all calculations of gear trains for taper turning on this lathe.

If we call this constant C, we can put together the following formula to determine C.

$$C = \frac{A \times P \times D}{S \times B}$$

or for the purpose of the demonstration machine,

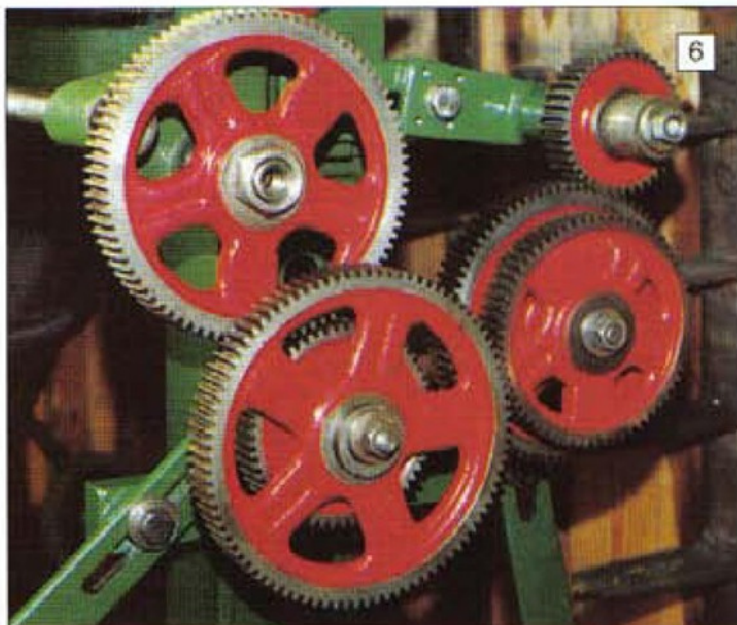
$$C = \frac{20 \times 0.25 \times 0.5}{0.25 \times 1}$$

therefore, on my machine:-

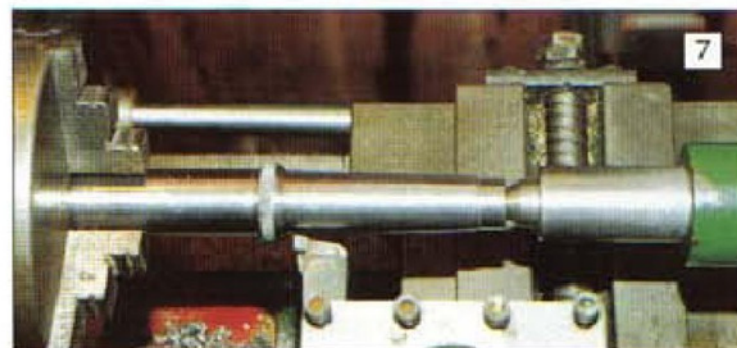
$$C = 10$$

What all this really means is that, when

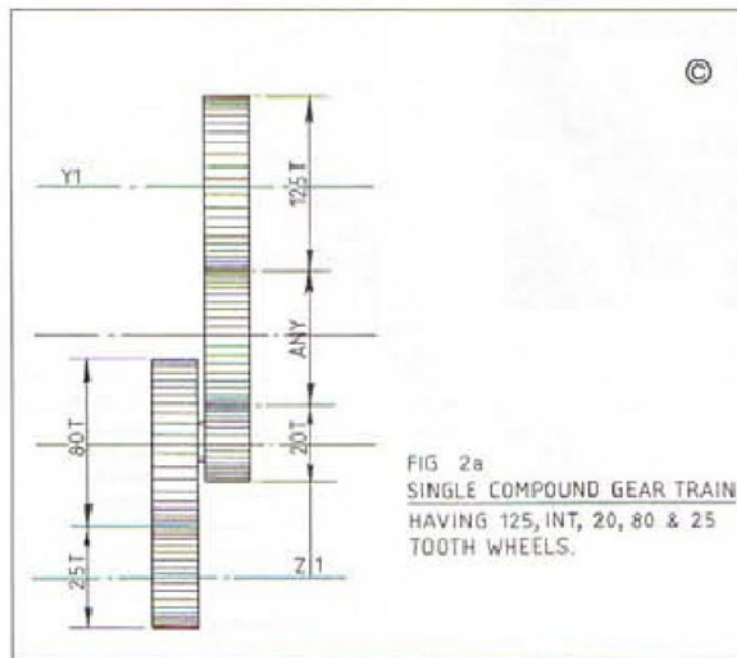




6: A double compound train (6 wheels).



7: The end product of photo 1. A good Morse taper.



the feedshaft revolves one full turn, the 20 tooth pinion on the cross slide screw turns the screw  $\frac{1}{20}$  full turn. Given that the cross slide screw pitch is 0.25in., then the cross slide moves  $\frac{1}{20}$  inch. Forty revolutions of the feed screw move the cross slide 0.5in., which is 1 in. on diameter, so on and so forth. As the leadscrew of the lathe is also 0.25in. pitch, it will have to make 4 turns to move the saddle 1in. longitudinally as the

cross slide moves  $\frac{1}{2}$ in. This makes the ratio between the leadscrew and the feed screw:-

$$\frac{40}{4} = \frac{10}{1} \text{ or our constant (C) of 10.}$$

Calculation of gear trains

To calculate the gear train required to turn a given cone, the 'conical ratio' has to be found, which is:-

$$\frac{\text{length of cone}}{\text{large dia.} - \text{small dia.}}$$

The constant (C) of the lathe is then divided by the conical ratio, giving a new ratio which is the ratio between the backshaft (Y1) and the leadscrew (Z1). A train of connecting gears can now be selected to transmit this ratio.

For example, we will produce a cone with a large diameter of 0.950in. and a small diameter of 0.788 inch. The cone length will be 3.25 inches.

First we find the conical ratio of the component.

$$\frac{3.25}{0.950 - 0.788} = 20.06$$

Therefore the conical ratio is 1:20.06, which can be rounded down to 1:20. The lathe constant (10 in our case), divided by the conical ratio, gives the ratio required between the backshaft (Y1) and the leadscrew (Z1), that is to say:-

$$\frac{10}{20} \text{ (or } \frac{1}{2})$$

Since the gear train must consist of at least 4 gears, a suitable simple train could be:-

$$50 (Y1), 60, 60, 100 (Z1).$$

The 60T wheels are simply intermediates to make up the distance, neither drivers nor driven.

To prove this gear train we can say,

$$\frac{\text{driven gear (Z1)}}{\text{driving gear (Y1)}} \times \frac{C}{1} = \text{Ratio}$$

$$\text{thus, } \frac{100 \times 10}{50 \times 1} = \frac{1000}{50} = 1:20$$

The intermediates can have any number of teeth.

An alternative simple gear train for this cone could be:-

20 (Y1), 30, 120, 40 (Z1), which demonstrates that if certain gears are in already in use, a different train can be used to obtain the same result.

Anyone producing this particular taper on their lathe will find it to be quite a good No.3 Morse taper, being less than 0.0006in. out of taper over its length, or about  $\frac{1}{200}$  deg. out of angle (remember our conical ratio was actually 1:20.06). I have on occasions carried out production runs on Morse tapers, one instance was the manufacture of two dozen shanks for metal spinning tools, each with a No.3 Morse taper, to interchange in a handle with a 3MT socket. The gear train for taper turning was easily set up and the tapers could be turned on automatic feed.

## Compound gear trains

We have already seen that a minimum 4-gear train between the backshaft and the leadscrew is needed to connect them together and create the correct ratio for the taper to be produced but, just like the gears at the headstock for screw cutting, a compound gear train can be used to generate even more tapers than can be produced from a simple train. If the smallest gear has 20 teeth and the largest gear has 120 teeth, then if the 20t gear is on the backshaft and the 120t gear is on the leadscrew, a cone of 1:60 (0deg. 57min. 18sec.) is produced. If the 120t gear is on the backshaft and the 20t gear is on the leadscrew, a cone of 1:1.666 (33deg.



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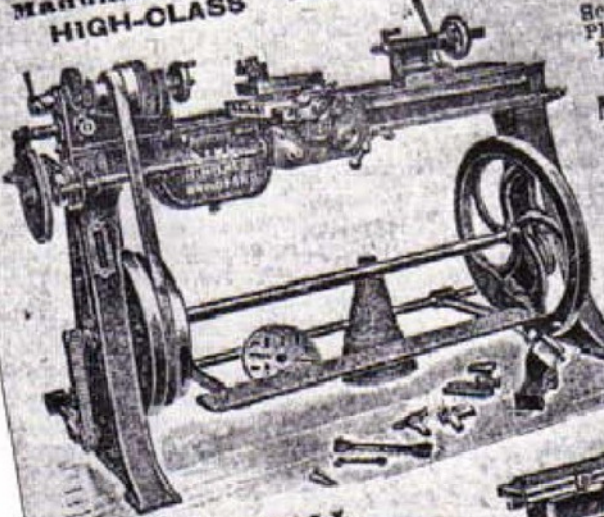
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$$\frac{\text{driven gears multiplied together}}{\text{driving gears multiplied together}} \times \frac{C}{1}$$

or,

$$\frac{20 \times 25 \times 10}{125 \times 80 \times 1} = \frac{5000}{10000} = 1:0.5$$

Then the cone turned is the very useful taper of 90deg. included angle. As this angle is steeper than 33deg. 23min. 56sec. (1:1.666) it cannot be produced with a simple gear train from our change wheels. We would need a driven gear of 400 teeth being driven by a 20t gear, which is not practical. It is much easier to build up a train allowing the use of more gears as has been shown.

A single compound train selected from our set of change wheels is now limited to a taper of 1:0.3623 (108deg. 8min. 36sec.). No matter how the gears are arranged, a steeper angle cannot be produced. On the other hand the shallowest angle that can be produced is 1:276 (0deg. 12min. 30sec.), not much of an angle at all. If we want to produce a cone steeper than 1:0.3623 we will have to employ even more change wheels. We can then build up a double compound gear train (Fig. 2b). In this example the cone turned would have a conical ratio of 1:0.2889 giving an included angle of 119deg. 57min. If we were looking for an included angle of 120deg. (1:0.2887), this cone could be quite acceptable, being only 3 min. out of angle.

Using our change wheels the two extremes of angle are 1:1012 (0deg. 3min. 24sec.) and 1:0.099 (157deg. 36min. 2sec.). If you have a 127t wheel, this increases the scope to 1:0.0855871 (160deg. 35min. 36sec.) and if you have a 127t and a duplicate 20t, 1:0.057058 (160deg. 59min. 14sec.) is possible. It has been calculated that a set of change wheels containing twenty different sizes can be arranged to give 380 separate gear combinations, 29070 differing 4-gear combinations, and 775200 6-gear combinations, a grand total of 804650 combinations. Although many of these combinations are duplicated by different set-ups giving the same ratio, the number of different ratios obtainable from this set of change wheels is around 750000.

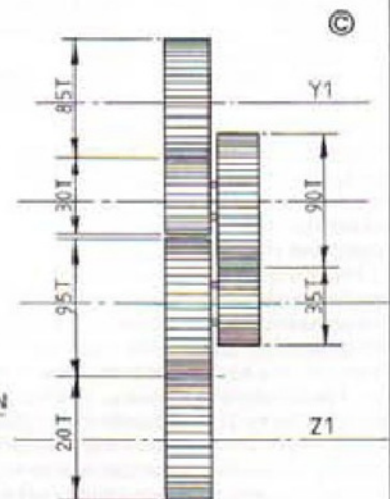
Finally, it must be pointed out that the photographs showing gear trains are 'unguarded' for illustration purposes, but in reality it is essential that these trains have guards which totally enclose them.

23min. 56sec.) is produced. If a taper which is shallower than 1:60 or steeper than 1:1.666 is required, it will not be possible with a simple gear train from the existing set of change wheels and a compound train will have to be used.

There are two types of compound gear train which can be assembled on our four centres. The single compound train (Fig. 2a) and the 'double compound' train (Fig. 2b). The single compound train includes an intermediate gear which can be any convenient size, the number of teeth cannot affect the overall ratio of the train, similar to the simple train. The double compound train has no intermediate gears and every gear must be carefully selected.

If we set up a single compound gear train as in Fig. 2a., and prove the train by saying,

FIG. 2b  
DOUBLE COMPOUND GEAR TRAIN  
HAVING 85, 30, 90, 35, 95, & 20  
TOOTH WHEELS





# BUYING AND RENOVATING

## A SECOND HAND LATHE

The majority of home workshops contain one or more machines which have been bought second hand, particularly if they are of the larger variety. Acquiring and renovating one of these can be a challenging exercise. David Machin describes his experiences and gives some tips to those who may be setting out along the same path.

**W**ith the requirements for National Curriculum Design and Technology in English and Welsh Education, many secondary schools are finding that they need their metalworking lathes less and less. The fact that I regret that today's youngsters are not exposed to the joys of extensive lathe work is incidental.

For we home machinists, many lathes are becoming available cheaply, and this article attempts to assist those readers who are considering buying such a machine.

I believe I am well placed to assist in this area for two reasons:

1). I have spent 30 years teaching heavy craft in secondary schools (now retired).

2). I have recently bought a lathe at a very attractive price from a school of which I had no knowledge. The lathe, a Kerry, was one with which I had no previous experience.

When choosing a lathe, it is wise to first consider size. The size of a lathe is determined by its centre height (or swing) and distance between centres. Centre height is the distance between the bed and the axis of the lathe (Fig. 1). Swing is simply twice the centre height. Distance between centres is the length of workpiece that can be accommodated between headstock and tailstock (also shown on Fig. 1). In practice, centre height will determine the largest diameter workpiece that can be accommodated, and distance between centres will determine the greatest length of workpiece that may be accommodated.

There are other aspects of centre height which need developing. Generally, the greater the centre height, the larger the bore of the spindle or mandrel. For example, the Myford spindle bore is  $\frac{5}{16}$ in. dia. The Boxford is  $\frac{3}{4}$ in. dia. The Harrison 140 and Kerry 1124 are both  $1\frac{1}{8}$ in. dia. These larger bores allow easy machining of long workpieces of larger diameter. Another aspect of centre height is that

some lathes have gaps in the bed just underneath the spindle nose. These are either 'cast-in', as on the Myford, or as a removable gap piece, as on the Kerry or Harrison. The Boxford has no gap. These gaps allow machining of very large diameter workpieces, usually mounted on a faceplate, but such pieces must be short enough to swing in the gap. The Kerry 1124 will swing 17in. in the gap. This is useful for machining the larger scale traction engine wheel rims, for example.

On another aspect of size, can your workshop accommodate the overall lathe dimensions? In this respect, it is a good plan to make provision for (a) removal of parts for servicing, such as motor, leadscrew and headstock change wheels, etc. (Fig. 2) and (b) long workpieces protruding from the back of the headstock, as well as the need for removing a centre with a long piece of bar. One friend of mine has made a 'porthole' in his workshop wall to accommodate long pieces!

Before leaving the subject of size, it may be worth stating that, for fine work on very small parts, the Myford and Boxford lathes are much more preferable

than the larger machines. When I bought the Kerry lathe, I had no intention of selling my Myford. The two machines complement each other, and which one I use will mostly depend on the size of the workpiece.

Having decided what size of machine, the next question is which make? My advice is to be open minded; if you are offered a good machine at a bargain price, but it is not the make you are looking for, you could either be disappointed or be looking for a long time. Most school machines are from good British manufacturers, such as Myford, Denford, Boxford, Harrison, Colchester or Kerry. Any one of these would serve the needs of the home machinist very well indeed. There is one word of caution: some lathes are not made any more and some manufacturers - like Kerry Engineering - are no longer in business. So spare parts are going to be a problem. However, during my time in workshops, the only spares required were drive belts. Where these cannot be obtained from the original maker, a good source is a motor car spares shop or, failing that, a specialist belt supplier. Accessories such as steadies, faceplates, vertical slides and change wheels may be a different story, and depending on your requirements, may deter you from buying. It pays to ask what accessories are available. Many accessories can be bought separately, but this can be very expensive. The chucks and their condition, is also worthy of investigation for the same reason. For example, with the lathe I bought recently, one of the

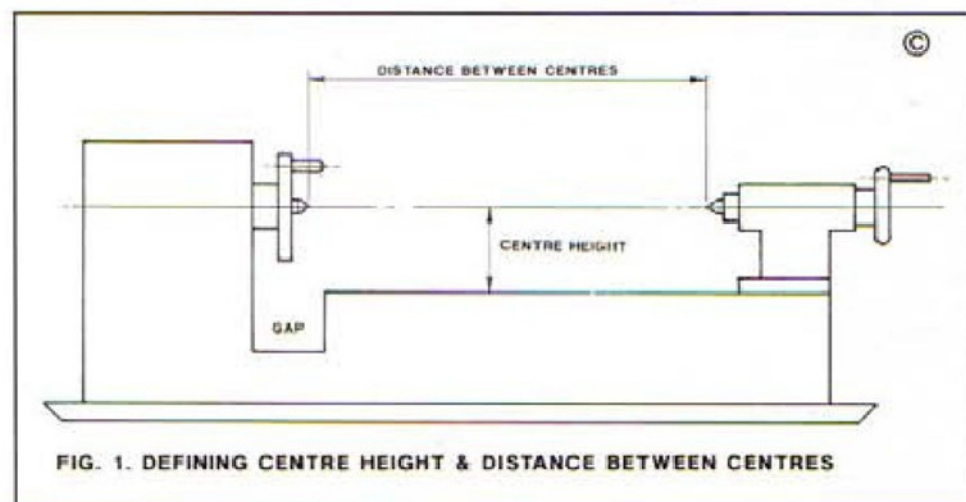


FIG. 1. DEFINING CENTRE HEIGHT & DISTANCE BETWEEN CENTRES



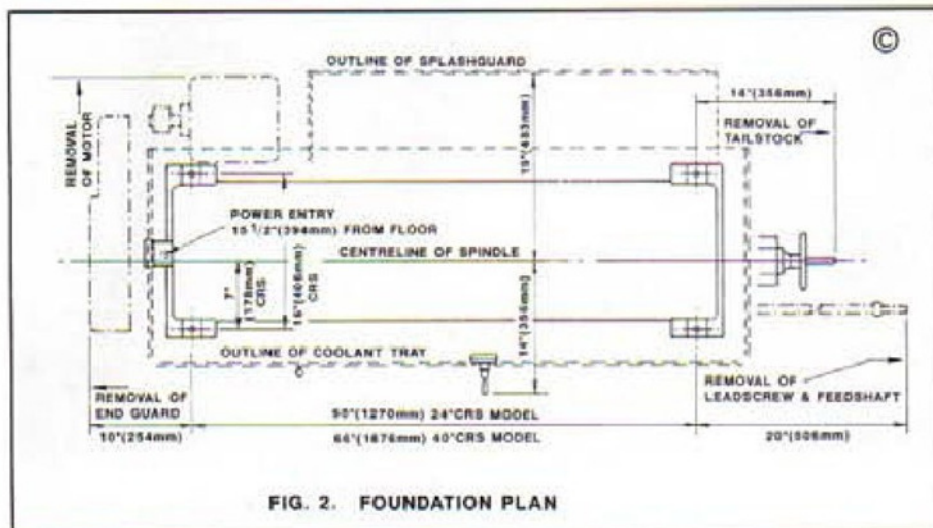


FIG. 2. FOUNDATION PLAN

jaws on the 4 jaw chuck is dimensionally different from the other three, though it fits the body of the chuck. I failed to spot this and, no doubt, a replacement will be expensive, even second-hand.

After all the foregoing points have been considered, you next need to consider sources of supply. Adverts are an obvious place to look; specialist suppliers of second-hand machines have been advertising for some time. Most of their machinery is ex-school, so they will be wanting their profit, which will increase the price. The ideal situation is to buy direct from a school if possible. Often schools advertise internally, via the Local Authority Bulletin For Schools, usually weekly. You could ask a teacher friend to keep an eye open on your behalf. Joining an evening class in metalwork or woodwork can also be a useful ear on the grapevine. Failing this, a short letter to the Head of C.D.T. or Head of Technology of a school, with a prepaid reply slip may yield results. Expect some disappointments.

Having established contact and availability, the next thing is to inspect the machine(s). A list of pointers may be useful:

- 1). Look over the machine generally. The paintwork condition will depend on age. In any case, it will probably be chipped. Don't be put off by this. Overzealous sweeping down and dropping of spanners and tools need not condemn a lathe. It's amazing what a lick of paint will do, but it is superficial. More important is whether the oiling points have seen oil regularly. General dryness or thin black 'gunge' on slideways would suggest the opposite, which could spell accelerated wear.
- 2). Run the machine, if possible. If the headstock is all geared, run every speed. There should be no intermittent noise. If there is, a tooth could be missing on one or more of the gears. On lathes with belt change and back gear (Boxford, Myford etc.), a run in back gear is essential to check for missing teeth. Early Boxfords were particularly prone to this, as there was no microswitch on the backgear lever to stop the motor when changing gear. Some pupils will try anything!
- 3). Check the headstock spindle or mandrel bearings by gripping the chuck firmly and attempting a sideways movement. There should be none, but on

some lathes this is adjustable. More on this later.

4). Remove the chuck, and check the condition of the mandrel nose: both thread and register (or taper on large machines). **Photo 1** shows such a taper, in this case an American type LOO taper. Any abuse marks could either terminate the sale, or if not too serious, should reduce the price. Larger machines having the LOO taper are particularly prone to this, where swarf is trapped between chuck and mandrel. Some restoration work is possible, (to be dealt with later). Internal condition of the mandrel taper is also important, and again swarf can be trapped between centre and mandrel. This is curable. Not curable is where someone has 'modified' the taper with either a boring tool or large drill; this is unlikely, and in any case, most mandrels are hardened.

5). Inspect the bed. If it looks as though it's been planished (hammered) or filed all over, move on! A few dents and bruises are to be expected, for example, where chucks have been allowed to fall on to the bed. It happens! You know, and I know that a wooden board over the bed will protect it, but not all pupils follow the rules! See later for some palliatives.

6). Check the bed for twist. Using a spirit level, place this across the bed at each end in turn. Even if not level, the readings should be the same. If not the lathe will never turn parallel. This condition is more likely on the lighter lathes: Boxford, Myford, etc. If serious, reject.

7). Check the bed for wear: inspect the flat or V ways for scoring. Most wear occurs close to the chuck, so inevitably, the saddle, when moved towards the tailstock, will encounter more resistance. This gives an indication of wear, too, but may be masked by loose gib or saddle strips. Again, if not too serious there are cures in most cases.

8). Cross slide and top slides can be treated in the same way as the bed, though the difference is that whilst some beds are hardened and ground, these slides are generally not, so can be cured if wear is not too serious.

9). Leadscrew and feedshaft (if fitted). Where a lathe has a feedshaft, the leadscrew is usually in excellent condition on school lathes, since not much screwcutting will have been done. On

Boxford lathes with power cross-feed (AUD, BUD), the same will apply, because these versions have a keyway machined down the leadscrew. This actuates all auto-traverse functions, not the thread of the leadscrew. On lathes where the leadscrew powers auto-traverse (Boxford CUD, Myford), then expect some wear, particularly in the most used area near the chuck. In most cases, this will not be a problem unless you expect to make a lead screw to N.P.L. standards! Feedshafts usually present no problems, unless bent. This is unlikely.

10). Change wheels can easily be checked by inspection. Gearboxes, if fitted, should be listened to on all pitch settings to check for toothless wheels and bent shafts due to engagement whilst a lathe is running. Again these problems are unlikely, though not unheard of.

11). The front apron can only be checked by running the machine, and testing all functions. If you are unfamiliar with the machine, ask for a demonstration.

12). Motors and electrical equipment give little trouble. Don't be put off by three phase. Most school lathes are, and as you will see, there are inexpensive solutions.

## Getting it home

Having made your selection and agreed the price, you are now faced with getting your machine home. (Incidentally, there may be a disconnection charge, since many school staff - including technicians - are forbidden to touch the electrics). Mode of transport will depend on its weight. A Myford (less stand) can be lifted by two (strong) men. Four (strong) men are capable of lifting a Boxford on its cabinet, provided that steel bars are positioned through the holes provided in the cabinet. The machine could then be placed on a four-wheel bogie. Most schools have one of these, and may be willing to loan it to you. Lathes larger (and heavier) than this require different treatment. To move any machine, particularly a heavy machine, (on its cabinet) along a level, smooth, hard, floor is fairly easily done on rollers - lengths of round bar. A lever can be used - with a suitable fulcrum - to lift the lathe at each end. The rollers can then be placed in position underneath. (It helps to remove all items from the cabinet!). This will get the machine to the entrance. If there is a step, then long hardwood wedges will be needed - and some strong pushers! The ideal from the doorway is a small lorry with a hydraulic crane. In the absence of such a vehicle, a small trailer may be used. Here, the trailer could be brought up to the entrance and its floor level packed up to the doorway level for loading. It needs to be a strong trailer! A low loader may be better, particularly if fitted with a winch. Vans probably have too high a floor, which may also be too weak to withstand the weight.

If a lathe is really heavy (Harrison, Kerry, Colchester, etc.) it may be prudent to employ the services of a machine mover or haulier. Most will quote, and it could be a good plan to do this to





urgent a requirement, because these machines are inherently rigid. To twist the bed on these machines would probably require them to be rag bolted down on to an uneven floor. However, they do have tapped holes in the cabinet feet, with jack screws, so again levelling is made easy, using a spirit level as already described.

this kind will have to wait. In that case, make drawings of the parts for later construction before reassembling the old parts to, at least, get started.

Assemblies receiving the cleaning, oiling and inspection in my case were: saddle, apron, cross-slide, top-slide, change wheel gear train, gearbox and tailstock. Note that the headstock was untouched at this stage, because being all-gearbed, the headstock was totally enclosed, therefore (internally) relatively clean. I did drain the old oil, flush with thin oil, and finally refill with new oil. Another reason for not disassembling the headstock was that it could have led to a loss of accuracy. More on this later.

Perhaps mention should be made of special tools for dismantling. If these are not available, it pays to make tools such as peg spanners (Photo 3) to fit the type of application shown in Photo 4. It's possible to use pin punches, or other means, but these do make a mess of the ring nut.

## Reconditioning

Now to some reconditioning, where this is found necessary. First a look at the mandrel or spindle 'nose', both internal and external. In the case of an external LOO taper, it will almost certainly be hardened. If there is any bruising, the offending portion may be stoned i.e. an oil stone used to carefully remove any burr. More likely is that pieces of swarf have become embedded in the chuck's internal taper. These can be carefully scraped away using a half-round scraper. If this is extensive, a check may be made using the mandrel nose taper as a master surface. Engineers' blue is thinly smeared on the mandrel taper, the chuck is then fitted and tightened. On removal, blue should be seen on 95% of the internal taper. If not, further scraping and checking may be carried out. All chucks and the faceplate may need this treatment. The catchplate is least likely to require attention, since it will have seen little use.

Regarding the internal taper, this should be carefully examined and any pieces of flattened swarf carefully removed with a small half-round scraper. The taper may be tested by smearing engineers' blue on to a clean burr-free centre or sleeve as appropriate, then fitting and removing the item. Inspecting the internal taper in good light should then show up any remaining swarf requiring removal. I doubt whether any other misuse will be found.

Screw nose mandrels are usually in good condition, because the fitted chuck protects them. In any case, the mandrel is usually hardened. If any abuse is found, then careful stoning of the offending portion may be carried out. More likely is to find pieces of swarf embedded at the root of the threads of the chucks. These can be



## Cleaning and inspection

Next, give the machine a thorough external clean using paraffin and an old paint brush to loosen the dirt (Photo 2). Dry off with rags or kitchen paper towels. If the restorative work is to be over a long period, spray all bare metal with WD40 (usual disclaimer). Then,

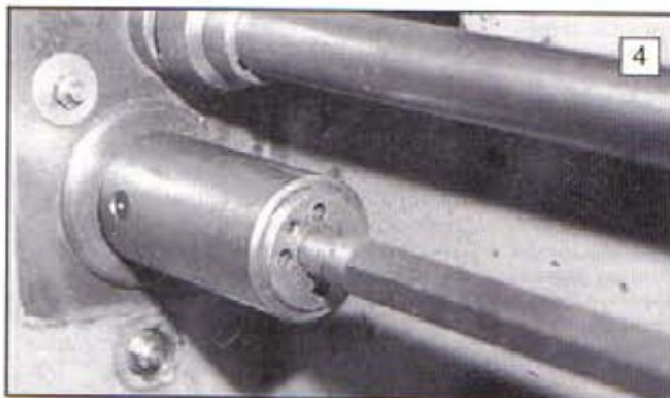
begin the internal cleaning and inspection. It is best to dismantle, clean and reassemble one section at a time; for example, the apron. If you have no detail drawings of the assemblies, you have to be very careful to note how these are put together. Make notes and drawings and take photographs, if necessary, before and during dismantling. What I found with most assemblies on the Kerry was that, with a small number of exceptions, they were in reasonable condition, but very dirty. The exceptions were several blocked oilways, due to oil nipples being filled with grease instead of oil. These were drilled out. In one case, a plain bearing in the change wheel train was in very bad condition. The bearing was iron, running on a steel shaft - fine if lubricated with oil. The shaft was badly scored and the iron bearing, which carried a pair of gears, was scored and cracked. When spares aren't available, they have to be made, and I have to admit that having a first lathe already in service (the Myford) made making these parts easy. For those who have only the one machine, parts of



determine the cost of the whole project before finalising any deal.

Before finally departing with your purchase, do make sure you have left nothing behind, particularly (if available) the lathe handbook.

Having got the lathe home, and positioned, check that any twist in the bed is eliminated. On Myfords, this is done with the jacking screws mounted in the raising blocks. Boxforbs have to be adjusted from cabinet mounting points, using jack screws and lock nuts. (These should have been taken along with the lathe at the time of collection). On Harrison and Kerry lathes, it is not so







removed using the 'bent end' of a scribe. In his excellent book, 'The Amateur's Lathe', L. H. Sparey recommends a special tool for this purpose, the points of which are ground to the thread angle - 55 degrees for Whitworth, 60 for metric. On screwed chucks the register is, of course, most important for accuracy, and a possible area for abuse, particularly if the chuck has been stored 'jaws up'. Again, bruising can be dealt with as previously described.

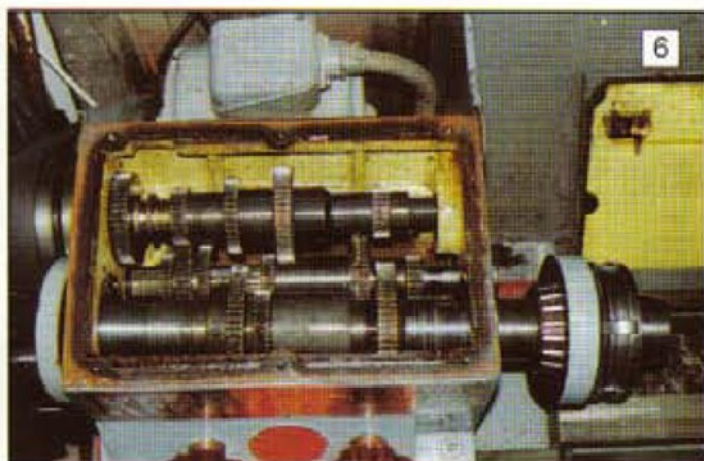
The final arbiter is, of course, DTI testing of all chucks, to ensure that the backplate, at least, runs true. Where it doesn't, and the checks and 'adjustments' mentioned above have been carried out, re-machining of the backplate may be needed, if sufficient metal is available. Where it isn't, a new backplate may have to be considered - either made from a casting or bought as a spare part, if this is possible. If considering machining your own, do be careful to check the fitting of chuck body to backplate. Some chuck bodies have a special backplate which forms part of the 'innards' of the chuck. Some chucks do not have backplates and the whole chuck body has an integral screw and register, rendering re-machining to regain former accuracy difficult, if not impossible, in the home workshop. When using the lathe, don't expect perfect centring of workpieces in the three jaw chuck; it is almost certain to be a little worn.

I mentioned earlier the plain bearing in the change wheel train. This was reconditioned by machining the scored shaft down from its nominal  $\frac{3}{4}$ in. dia. to

$\frac{5}{16}$ in. dia. for a suitable length then making what was in effect a mild steel tube of  $\frac{3}{16}$ in. dia. bore and  $\frac{3}{16}$ in. outside dia. This was then 'glued' to the old shaft using Loctite high strength adhesive. The oil holes had been carefully drilled in the 'tube' so that they matched the original ones in the shaft. The reason for not simply fitting completely new was that the rest of the shaft was the detent for the all-gear head (see later for the headstock drawing). The bush could have been made in cast iron as the original, but since I had a suitable piece of mild steel, I used this, and fitted sintered bronze bushes. The latter are readily available in standard inch and metric diameters and of varying lengths, from bearing suppliers. These are found in many applications on lathes, and thus can be used in the reconditioning process by simple replacement.

Where a hole in a cast iron part is very worn, there is no reason why a sintered bronze bush should not be used to restore it, having first re-machined the hole to a standard oversize. Of course, care should be taken to relocate the hole on the original centre, particularly if the worn hole is now out-of-round. The size of the hole for a sintered bush should be a light press fit. I have found that a standard sized reamed hole is perfectly satisfactory, but do check very carefully.

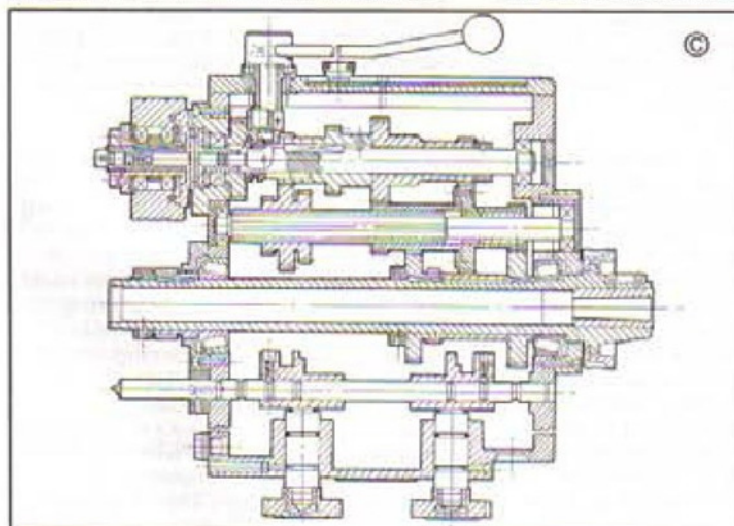
Where a shaft is worn, even if originally hardened, EN1A mild steel is probably quite satisfactory, since you will not, presumably, be running your lathe 24 hours a day, seven days a week! If you have



it or can obtain it, steel to spec. EN8 will wear better even if you don't harden it.

Ball bearings including thrust races last a long time, but if worn, are replaceable, and obtainable from bearing suppliers. The handbook supplied with the lathe will give the bearing numbers. Failing that, the bearings themselves are stamped with the numbers. Roller bearings are similarly identified and available. The latter are sometimes found in headstocks, which brings me to the next piece of reconditioning.

When I removed the previously mentioned plain bearing assembly, it necessitated removing the mandrel bearing ring nut. I found that this had previously been removed and replaced before I bought the machine. On refitting the nut I checked for end float of the mandrel. When fitted to the previously marked position, the end float was excessive, so I duly adjusted the ring nut to bring the end float to the prescribed 0.0005in. The mandrel was then difficult to turn and felt decidedly rough. This was a situation I had not envisaged, and found quite worrying. If I were to replace the bearings, would I lose the accuracy? I decided to seek information on this, and to cut a long story short, received the advice of a professional engineer, expert in machine tools. His advice was that replacing the bearings should not affect the accuracy and, even if it was affected, I could always take a light skim (using a carbide tool) to restore the tapers to true running. Thus emboldened, I bought new bearings. On price, it pays to shop around - they can be expensive. In replacing the bearings, the lathe handbook was invaluable, because it contained a







caused by turning the ring nut. Putting a spacer in (another gear) allowed the bearing to be pressed fully home.

The main mandrel could now be refitted making sure that all headstock internal parts were also put on at the same time! The rear inner race could now be pressed on, again using the lathe's own parts to do it - in this case, a gear to act as a spacer and the other ring nut to do the pressing (Photo 12). Note the use of the four jaw chuck gripping a piece of square bar. This is to take the torque of the screw movement. The wooden board is to protect the lathe bed. All of the parts could then be reassembled and the end float set.

With bated breath, I then did some preliminary tests, using a DTI. The run out (wobble) on the mandrel nose was 0.0002 in. - the same as when the lathe was first made and tested! Phew! What a relief! Further testing necessitated the use of a test bar, which was made on the Myford. Where a second lathe is not available, it would pay to make this test bar first.

The test bar, in this case, consists of a piece of approximately 1in. dia. bar of 12in. length, plus about 4 inches for the No. 3 Morse taper and the driving dog. This can be seen being machined in Photo 13. Note the use of the travelling steady. This bar could then be used for further tests. Run out at 12in. from the headstock was the same as when the lathe was new - 0.0014in. Photo 14 shows this test being carried out. Near the headstock, the run out was 0.0002 in., again, as new. A test of run out using the face plate varied between 0.00075in. and 0.0015in., against an allowed 0.001in. This is probably a distorted face plate, but the error is very small. Greatly relieved, I allowed myself a short pause for a celebratory cup of engineman's best friend!

## Other mandrel bearings

I have described the fitting of the roller bearings in some detail, but I must say that the need for bearing renewal is rare. What of other machines? The Myford ML7 has plain bearings, and is adjusted by means of removal of one of the laminations of the shims between the bearing caps. This leads to out-of-roundness of the bearings, so some hand scraping is needed to restore the correct condition. The Super 7 has a tapered cone front bearing, with ball races at the rear. Here adjustment is made by moving the mandrel towards the tailstock to increase clearance, back to reduce. There are nuts at the rear of the mandrel to control this adjustment. Full details are provided in the instruction books - a must when making adjustments for either machine. The Harrison has a pair of taper roller bearings and a ball bearing. These need a small preload, adjustable by a ring nut. The Boxford has a pair of taper rollers, again adjusted by a ring nut. In all cases, I would repeat that replacement is rarely needed: adjustment should only be carried out if necessary, and then only with the maker's instructions. A reason for adjustment is 'chatter'. This is where

front inner race still on the shaft (Photo 6). This allowed the shaft to be removed, leaving the outer races still in the headstock (Photo 7). To remove the inner races from the shaft, I adopted the set-up shown in Photo 8, where the chuck draw nut is resting on the vice top whilst the shaft is forced through using the special drift again.

The outer races were gently drifted out using a brass drift at points round the circumference. I could now examine the bearings. Photo 9 shows the original cause of the roughness and stiffness: pitting of races and rollers.

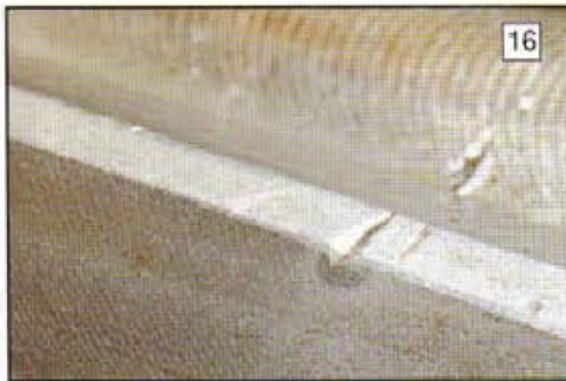
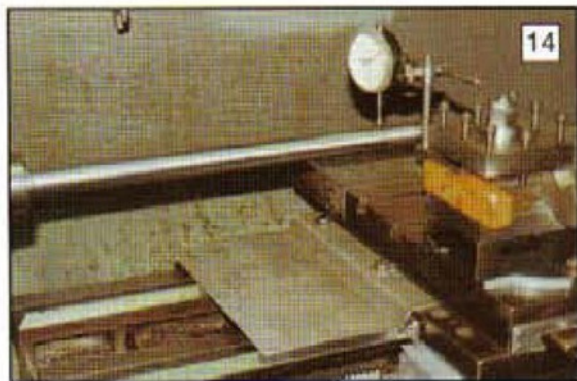
## Headstock re-assembly

After careful cleaning of all parts, I could now reassemble. The new outer races were fitted first, using a long length of studding and nuts, centred at one end by the method shown in Photo 10. They were then pressed home using part of the lathe's own clutch as a large washer, plus ordinary washers. The outer races are only a light press fit, but were difficult to start square. Perhaps a piece of studding of greater diameter would have helped here.

The inner race is a much tighter fit, and Photo 11 shows the method, using the lathe's own parts to fit it. Note that the chuck has been fitted to resist the torque

sectioned drawing of the headstock (Fig. 3). I could thus plan a strategy for removal and reassembly. I made a special drift in mild steel (Photo 5). Having removed all necessary parts, including the clutch, the special drift was used to drive out the shaft. This action released the inner race from the shaft, but left the





Put the saddle in position on the blueed area, moving it along the bed for a short distance and then lift off to inspect the 'ways' on the saddle (Photo 18). Where you have blue, you obviously have contact. Incomplete covering indicates wear. You can see in this case that little wear is evident. If you have experience

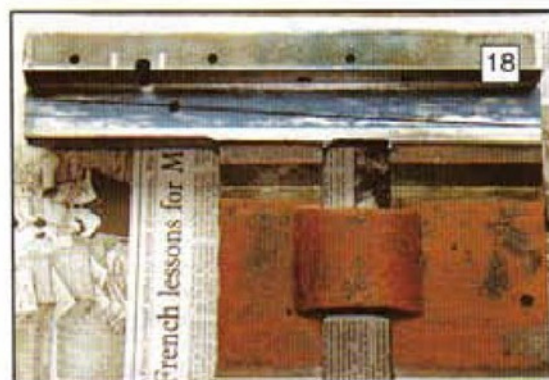


with a scraper, you can scrape off the high spots and test again, until 95% of the surface is covered in blue.

Other adjustments to be made depend on the type of bed and the type of lathe. On all lathes, there is a rear saddle strip. This wears very slowly and adjustment could be by removal of shims from the bolting face (Myford) or by grinding or scraping the bolting face of the strip itself (Kerry). There is usually some arrangement at the front of the saddle to prevent 'back lift' when cutting (using a back parting tool is a good example). A front saddle strip is not fitted to a Boxford. On the Myford, it's another saddle strip, with shims, while the Kerry has plungers which contact an angled face on the bed, with adjusting screws and locking nuts.

On lathes without V ways, for example the Myford, there will also be a gib strip. This is adjusted with screws and lock nuts.

All lathes will wear more near the headstock and where close adjustments are made to the saddle, you may find it too tight at the tailstock end. With hardened beds you could make a scraper with a tungsten-carbide tip and - if you are very brave - use it to scrape the high spots. Otherwise there is little you can do. With unhardened beds you can, of course, use an ordinary scraper. In either case, this needs great care and is probably not for the inexperienced. It may therefore be necessary to compromise on the adjustments. We can now turn our attention to the cross slide. After thorough cleaning and oiling, adjust the gib strip carefully. Do this with feed screw and nut removed. This will



vibration is apparent when cutting. It leaves a pattern on the workpiece (Photo 15) and usually happens when the lathe tool has more than point contact. Parting off is a good example of this.

A word of warning. Before embarking on headstock bearing adjustment, do check that the chatter is not caused by other factors, such as too much tool overhang, loose gibs on slides, insecure workpiece or too high a spindle speed.

## Sliding surfaces

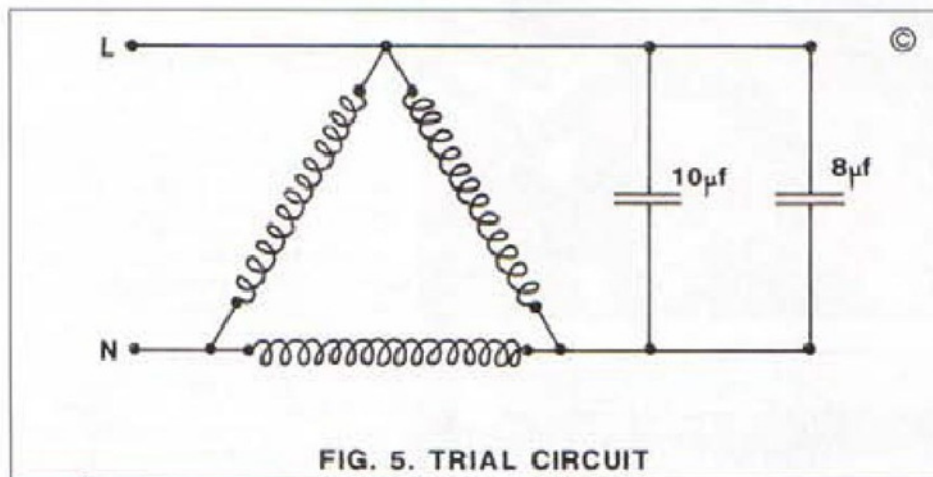
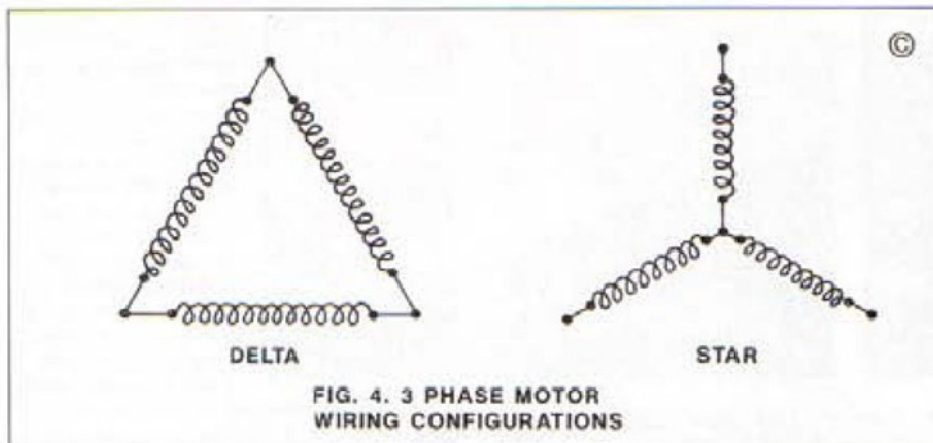
Now on to further restorative work, the bed and slideways. First the bed. If this is

hardened and ground, you may think that nothing can be done. For the odd bruising, a sharp, fine, dead smooth file is used to remove the burr thrown up around the bruise, to bring it level. Clearly, care is needed to keep the file level with the surrounding surface and to stop as soon as the burr is removed. An alternative to filing would be to use a flat oilstone. In all cases, take care that all filings and swarf are removed. Photo 16 shows a bruise after treatment with a file.

To check the wear on the saddle, you need first to remove it. Clean the 'V ways' and apply a thin layer of engineers' blue to that part of the bed which is least worn, i.e. near the tailstock (Photo 17).

eradicate any stiffness due to screw and nut misalignment problems. By pushing the slide backwards and forwards, you can set the gib nicely. In many cases, this is probably all it needs. On some lathes you may find, as I did on the Kerry, that the least used part of the traverse, near the rear of the lathe, is stiffer i.e. has less wear. Again, a compromise gib setting may be necessary. It is possible to scrape the 'ways' to equalise the wear. This needs doing with great care, since the cross slide controls the surfacing or facing cut, at 90 degrees to the bed. In practice, the cross slide 'ways' are ground at slightly less than 90 degrees, to ensure that a faced end on a workpiece is slightly





concave. The amount of concavity will depend on the quality of the lathe. The Kerry handbook states between 0.000in. and 0.001in. concave in 12in. dia. so there is little room for error.

I decided to have a go, tempered with caution. Since wear doesn't just take place on the 60 degree ways, but also on the flat portions, I decided to do these first. Using a surface plate - in my case, a piece of plate glass - I could get the underside of the cross slide flat first. **Photo 19** shows this being carried out. Having completed this, I could use it as a guide for scraping the flat portions of the saddle (**Photo 20**). With a large intake of breath, I then tackled the 60 degree ways. First using the surface plate for reference, I scraped in the gib. I now moved on to the saddle ways, using the gib for reference. Here I planned, in any case, to scrape more from the rear section of the faces to attempt to gain the original geometry. **Photo 21** illustrates this. Scraping was also carried out on the front V way on the cross slide. I did err on the side of caution, taking little off before testing and then trial reassembling.

I am pleased and relieved to say that this was successful, although proving it was difficult with what I believe is a distorted faceplate. The DTI test still shows this as 0.0015in. at worst and 0.00075in. at best. The proof is really to machine a large disc. I decided, therefore, not to risk the faceplate but to machine the face of the catchplate. With a straight edge across the face, it is impossible to introduce a 0.0015in. feeler gauge at the centre. When laid on a blued surface plate, it marked only on the edges, so it is facing concave and probably within the original limits set. The cross slide also

moves across with an even resistance.

The compound or top slide was next. Here the wear was fairly even, as I suspect it will be on most lathes. On the Kerry, the gib strip is tapered in thickness with the ways at the back tapered to match. The depth of the gib controls the clearance, and is adjusted by screws at each end. However, wear at the adjustment points on the gib meant that adjustment was a hit-and-miss affair. In the absence of spares, I decided to re-machine both slide and slideway, to make them parallel, and to make and fit a new parallel gib strip. Adjustment was to be by the usual grub screws and lock nuts.

I had a dovetail cutter (bought at last year's M.E. Exhibition) and after aligning the slide from the front (parallel) slideway, using a DTI, I carefully removed a minimum of metal, to bring the slideway parallel. **Photo 22** shows the dovetail cutter in action. The

slide was machined in the same way.

The new gib was made from EN3b mild steel, though EN8 would have been better. To machine the angles at top and bottom, I first made a pair of special blocks, with faces angled at 30 degrees. The embryo strip was then clamped to these blocks. **Photo 23** shows the set-up on the milling machine. Next, the slide was marked out for the tapped holes. The holes were drilled tapping size and before tapping, the parts were temporarily assembled with the gib in position, allowing the gib to be spotted through these holes, i.e. the depth of the point of the drill was drilled in to the gib. With the parts disassembled, the spotted holes in the gib were opened up to clearance size and to shallow depth. The holes in the slide could then be tapped. Before final assembly, the slides were scraped. The grub screws had a short spigot machined on their ends, with a radius machined on the tip. This has worked out well, and positive adjustment is now possible with a smooth movement of the slide.

### The drive motor

Finally, the electrics. Most machines are three phase and the Kerry was no exception. It has a 2hp motor, and the supply to it was the usual isolator, no volt and overload release starter, with a forward and reverse switch.

Originally, my plan was to fit a single phase motor and I did look into the phase converter option. With nothing settled, I was at the M. E. Exhibition and happened to look at a Nexus book, *Electric Motors* by Jim Cox. This really is an excellent book and in it, Mr. Cox explains how to run a 3 phase motor on single phase supply. Following his instructions, the motor is now running on a single phase supply with a minimal outlay.

If you intend to have a go, I would strongly recommend that you buy the book before proceeding. First, the motor must be wired in delta configuration, not star (**Fig. 4**). I found that I could do this with the Kerry motor. Rummaging around, I found a couple of AC capacitors. These were of 10 and 8 microfarad and probably came from old strip lights. I wired these in parallel, directly to the motor, in order to do a trial. I had little faith that I could make it work! The wiring set-up is shown in **Fig. 5**. When doing this, care is needed, of course, to make sure that no live wires can (a) come adrift, or (b) short on each other.

To my amazement, the motor started

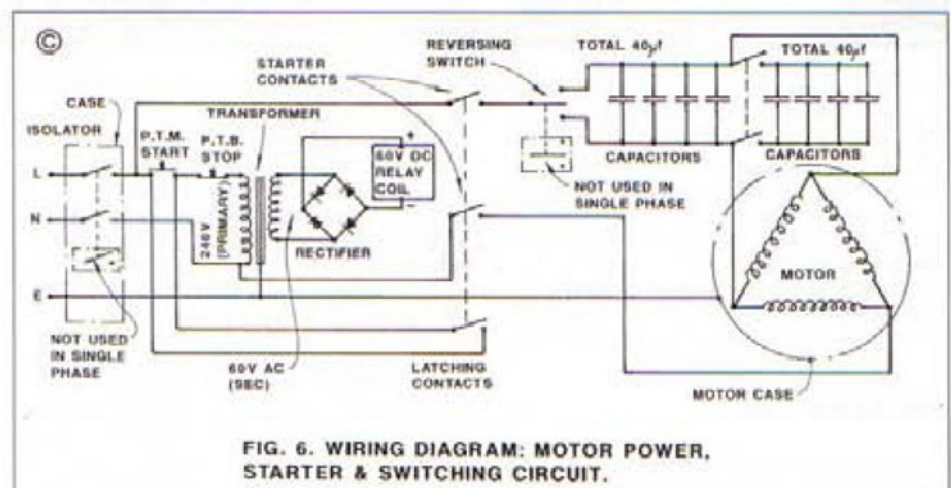


FIG. 6. WIRING DIAGRAM: MOTOR POWER, STARTER & SWITCHING CIRCUIT.



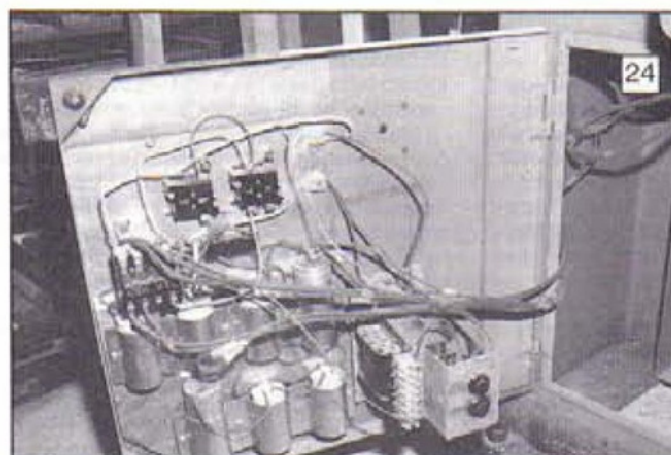


instantly and ran up to full speed. It should be stated that the start-up torque in this configuration is low, and a loaded motor will probably not start at all. Since the Kerry has a clutch, this was no problem. When I engaged the clutch, the lathe ran easily at the lower speeds but stalled at anything above 400 rpm, unless the clutch was let in very slowly. In any case, this was a try-out and in fact, the required capacitance for full load working at 2hp. is 80 microfarads.

Suitably encouraged, I then looked into obtaining the necessary capacitance. A local electronics dealer suggested that I buy AC. capacitors of 10 microfarads and wire these in parallel, gradually adding capacitors until the motor would run at its top speed of 1500 rpm. I found that the full 80 microfarads was needed to achieve this, but that the motor sounded rather noisy. I put this down to the fact that the phase shift achieved by the capacitors was not 120 degrees but 180 degrees. To reduce noise when the lathe is lightly loaded, I wired in a switch to give half capacitance. When full power is needed the switch is moved over to give full capacitance. In his book, Mr. Cox suggests extra capacitance above the 40 microfarads per horse power for starting. The Kerry motor didn't need this, because of the clutch, so I have omitted it.

I should say that the full 2hp is probably not available but for 'our' work, I find it adequate. Mr. Cox also gives a table for testing whether or not a motor is overheating. This needs an accurate resistance meter and I found that the motor was well within the margin of safety.

The Kerry lathe was originally fitted with a starter having a 380 volt coil, so this could not be used for starting. I happened to have a starter relay with a coil requiring 60v DC. This was given to me by a friend some years ago and I never throw anything away - even though, in this case, the voltage was rather odd to say the least. Some old telephone exchange equipment



was being scrapped at school and was sent to me to retrieve any useful parts. Among these was a 55v. transformer. I now only needed a rectifier, a push-to-

make switch and a push-to-break switch to complete the necessary parts list. Another rummage produced the necessary components and I could wire the system up permanently. The wiring diagram is shown at Fig. 6, with the practical - if a little crude - system shown in Photos 24 & 25. I should state that the 3 phase wiring loom was utilised and therefore some of the wires are not used. The most important item is, of course, to earth all metal parts and to check with either a meter or battery and bulb that any metal parts on the lathe are earthed - with mains power disconnected, of course!

The only part missing is an overload trip. It is intended to obtain and fit one of these in due course.

May I repeat that obtaining Mr. Cox's book is really essential if you intend delve into single phase / three phase electrics. I would like to take this opportunity of thanking him for writing it, to enable ordinary folk with little electrical knowledge - like me - to proceed with confidence into an area previously shrouded in mystery. Perhaps I should state that the book does not confine itself to matters dealt with above. There is a wealth of information on many other types of motor and their control. It is very readable and is written in plain English.

Finally, I hope the above information may be of some use, and that it will encourage those who have enthusiasm, but are perhaps short of the necessary cash to buy a new machine.

My thanks are due to my daughter, Catherine, and to my wife, Carole for help with the word processing for this article.





# NOW, HOW DO YOU GET IT HOME?

**Don Titus of Michigan, USA**  
tells us some of his  
experiences of moving  
heavy machinery and gives  
advice on the best way to  
go about it.

**M**oving machinery is tricky at best and if you're not careful it can be down right dangerous. My first advice is, if you can afford it, hire professional machinery movers! I am not a professional mover, I'm just a hobby machinist like many of you. The techniques in this article are things that have worked for me in the past. Every situation is different and you will have to determine whether they will work for you.

If you are a novice at buying and moving large metal working tools please bear in mind the following rule: 'There is an adverse relationship between the number of friends that are available to help you and the size of the machinery you need to move'. Without fail the bigger the machinery, the fewer the number of friends that are available to help and after the moving is done your pool of friends will probably get even smaller. My first venture into moving machinery and metal working was a 6in. Atlas Lathe which didn't pose a problem as it would go into the trunk of the car and I could move it by myself. My next venture was a Jet Mill/Drill with stand. I managed to convince a few friends that it would be a piece of cake moving the mill and that I figured it couldn't weigh more than a couple of hundred pounds. After the move I was informed that my weight estimate

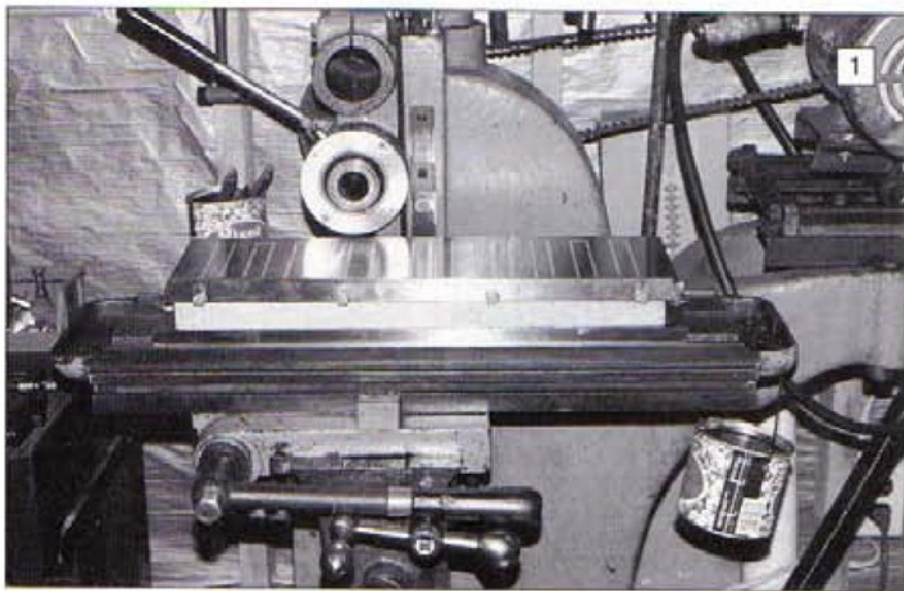
left a lot to be desired. Next came a vintage horizontal hand mill that I wanted to use as a make shift surface grinder. The company I bought it from sells used equipment and has an arrangement with a local towing company that uses their 'roll back' car hauler for this type of work. The mill was loaded on the truck with a forklift and for \$75.00 it was delivered to my garage. By rolling back the bed and using the winch on the front of the bed to keep tension on the mill, the truck driver slowly raised the front of the bed until the mill slid off, smooth as silk. Then it was just a matter of sliding it through the door in the back of the garage where the shop is located. Most towing companies charge by the mile, with a minimum charge being applied, this means the further the equipment needs to be hauled the more expensive it becomes.

My most recent moving situation occurred when I got that dreaded phone call, a friend's father was selling his 9in. South Bend in good condition, did I know anybody that was interested? At that time I had been looking for a 9in. South Bend with Quick Change Gears for over 4 years. During this time I had also come to find that my idea of good condition is usually different from others. I'll be the first to admit I'm a little particular when it comes to shelling out cold hard cash for used

equipment, I want to make sure I get the most for my money. During this 4 year quest, I had looked at more than 20 lathes. Some looked like they doubled as anvils in someone's shop, others had major parts missing or looked like they were used in 'drop tests. There was one thing they all had in common, they were advertised as being in very good to excellent condition. As luck would have it I had the next weekend free and decided to take a look, but due to past disappointments, did not get my hopes up.

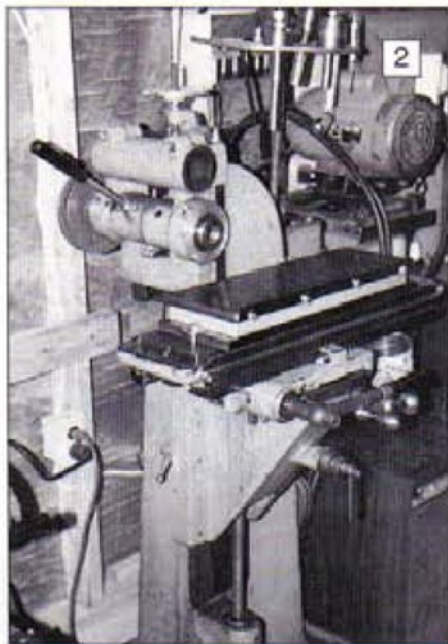
It took a little talking to convince my wife that I just wanted to see what it was and had no intentions of buying the lathe; somehow she knew I had been looking. She kept asking that age old question, "Why do you want to look at something you have no intentions of buying?" I think she just likes to see what new and innovative excuse I can come up with on the spur of the moment. After a little quick thinking we decided the 2 hour drive through the country might make a fun family outing, so we packed a lunch, loaded everyone in the car and we were off.

Over the years I have found that the better the deal the further away it is. I recently mentioned to my wife that it seemed anytime I found a deal it was always at least an hour's drive from the house. My wife kindly pointed out that this is because I have bought every Good Deal inside this radius, but that's another story. Upon arriving we went through the normal formalities, introductions, coffee and the normal chit chat. Soon the conversation turned to the task at hand and I was invited out to the garage to 'look at' the lathe; my wife decided to stay in the house and visit. The lathe was covered by a canvas tarp (cover) to keep the dust off it, when it was uncovered it was difficult to contain my excitement, the condition wasn't very good or excellent, it was mint! The bench drawers were full of tooling and I was informed that the wooden machinist's tool box filled with Starrett and Brown & Sharp tools, some with their original packing and boxes, went with the lathe. At that moment 4 years of looking turned to buying! It was also at this moment that I realised I was going to have to deal with a two , not so minor, problems. The first was convincing my wife that I really had no intentions of buying it when we came down and the other was moving it.

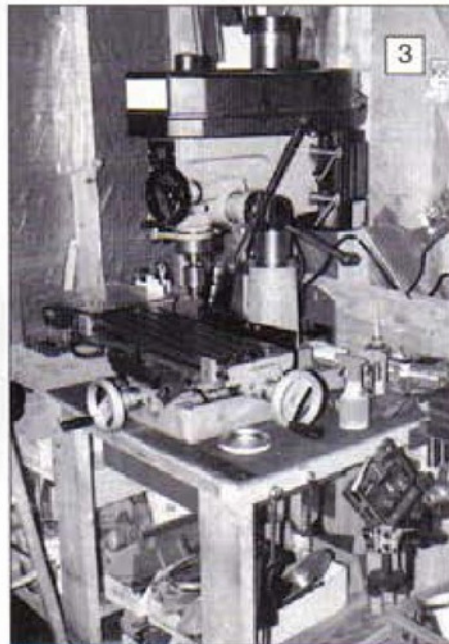


*Horizontal mill moved by roll-back car hauler*





**2: Horizontal mill (partial front view)**



**3: Jet mill/drill on wooden stand. Moved with strong backs and weak minds**

Have you ever noticed how the best deals always seem to pop up when you can least afford them? Back to the house we went. Somewhere between the garage and the house someone must have painted a sign on my forehead that said "he bought it", because as soon as I walked into the kitchen and sat down I knew she knew, 17 years of marriage does that to a person. We got the terms hammered out and the owner's son said he had a skidster (like a bobcat with forks instead of a bucket) he would use to load it for me. That took care of the problem of loading it, now all I had to do was figure out what I was going to load it on and how I was going to get it unloaded. We agreed on a deposit and I made arrangements to pick the lathe up the following weekend. I had a week to figure out how I would get it off the trailer, no problem. It sure was a long drive home!

At first my thoughts turned toward using the car hauler but due to the distance I had to rule it out as being too expensive in this case. My next option was to rent a trailer, which wasn't a problem, but I still had to figure out how to unload the lathe once I got it home. I figured the lathe and bench after removing everything from the drawers would be between 600 and 700 lb. so a trailer in the 1,000 to 1,500 lb. range would be sufficient and allow a margin of safety, just in case my weight estimates were off a little. Over the years I have found it wise, unless asked, not to offer information on what you are hauling to the people you rent the trailer from. They seem to think all metal working equipment weighs at least 4 tons and are usually reluctant to rent you anything less than a trailer capable of hauling a house, at a higher cost of course.

I still had the problem of how to unload the lathe once I got it home. The first thought that came to mind was to throw a 4 x 4 beam over the rafters in the garage and use a come-along or chain winch,

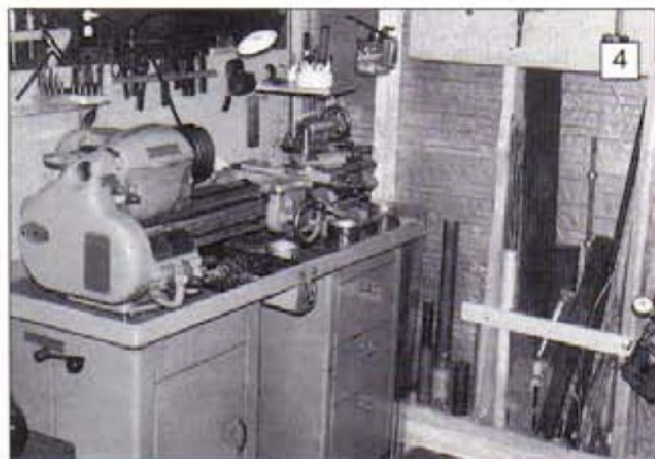
After surveying the rafters and knowing full well that if the rafters let go I would not only damage the lathe but might collapse the garage, I quickly discarded this option. I was explaining my problem to some people I know at the local archery range hoping for a solution or the offer of manual labour when one brave soul came forward with what seemed to be a simple and workable solution. He said why not use a 'Cherry Picker' (AKA free standing engine hoist)? He just used one with an extendible arm to pluck the engine out of his 4X4 pickup and he was sure it would work for this since it had a 2 ton jack and a 1000 lb. lift capability. He went on to explain that most of these have wheels to allow you to move the engine around once it is out of the vehicle, which would make moving the lathe into the shop a breeze. With a little convincing he agreed not only to let me borrow his Cherry Picker but also to help moving the lathe.

Early Saturday morning we were off with the trailer. When we arrived it took all of about 15 minutes to put a tow strap around the lathe bed, lift it with the skidster and set it in the trailer. We covered the lathe with plastic, used tie-down straps to cinch it down tight, said our good-byes and were off. When we got to the house I backed the trailer into the garage and we untied the lathe, then came the moment of truth. We fed a large tow strap in half forming a loop and slid the loop under the lathe bed and over the hook on the hoist. Then we hooked the other two loose ends (which have loops) of the tow strap to the hook

and slid the strap out toward the ends of the lathe for stability. The hoist worked like a charm! We lifted the lathe up just enough to pull the trailer out of the garage and immediately lowered the lathe to within an inch or two of the floor, just in case. The two of us wheeled the hoist and lathe to the door of the shop, set the lathe on the floor and slid it through the door and into place in the shop. I would have used the hoist to wheel it right into place but the door on the shop was too narrow, I'll plan better the next time. It took all of twenty minutes to unload the lathe and move it into place.

I hope this will help some of you who have passed up equipment because you had no way to move it. As long as you keep in mind the limitations of the equipment you are using you should be fine. To move the lathe, the only cost I incurred was the trailer at \$18.00, if I would have had to rent the engine hoist it would have cost me an additional \$25.00 and I could have also used it to load the lathe. I found that most places that rent tools and trailers also have the hoists available. Before you rent one do a little looking around, you can usually find someone who has an engine hoist or knows where to borrow one, especially if they think you are trying to recruit them to lift the heavy end of the equipment. If the machine is too large for the engine hoist, the car carrier seems to be the clear ticket, but make sure the garage door provides enough clearance. Most of the people who own car carriers need to pay the bills and are willing to haul anything legal, providing they don't have to physically lift anything. The person who hauled my mill said he has hauled big Bridgeports and lathes with no problems, just be sure to stay within the truck's weight limitations. For the folks that have their workshops in the basement or other than on ground level, I would highly recommend contacting your friendly neighbourhood rigging (machinery moving) company. They have the expertise to do the job safely and with little risk to your investment.

Remember the old phrase 'necessity is the mother of inventions', well that South Bend Lathe was a necessity and it sure looks and runs great. If I would have had to hire someone to move it, I would not have been able to afford it and for me that would have been a shame. I sincerely hope this starts the wheels turning!



**4 in. South Bend lathe. Moved by trailer and engine hoist**



# HAND SHAPERS AND VEE BLOCKS

A recent revival of interest in the hand shaper encouraged Harold Hall to acquire a secondhand example and to assess its capabilities by machining a pair of Vee blocks.

**D**uring my time as editor of M.E.W. it became apparent that there was more than a little interest in the use of a shaper in the home workshop. To understand its capabilities a little better, I purchased a small Adept hand shaper, well used, but still quite sound. It was while in the early stages of setting this up with the idea of an article in mind, that the excellent articles by Bill Morris became available. These, as readers of the magazine at the time will remember, related to a power shaper and were very detailed, to the point that I considered the required information had been furnished. However, it was not long before correspondence arrived full of compliments for the article but requesting that an item on its hand operated counterpart should also be published. This article is in response to these requests.

The shaper, purchased for a matter of a few tens of pounds, was obviously well used but appeared to be adequate for what was intended. Two approaches were considered. The first, to strip down the machine and refurbish it; alternatively, to use the machine, in the first instance, in the as purchased state.

The ram was a little loose in the centre portion of its travel, but, as the task in mind required to use practically the whole of the ram's movement, tightening it up so that there was no play in the middle was out of the question, as it would then become too tight at each end. There was also the question of how parallel the table was to the ram's movement, both in the X and Y directions. All this looked like a lot of work to improve the accuracy of the machine, especially so if subsequently found to be too much like hard work to operate and, as a result,



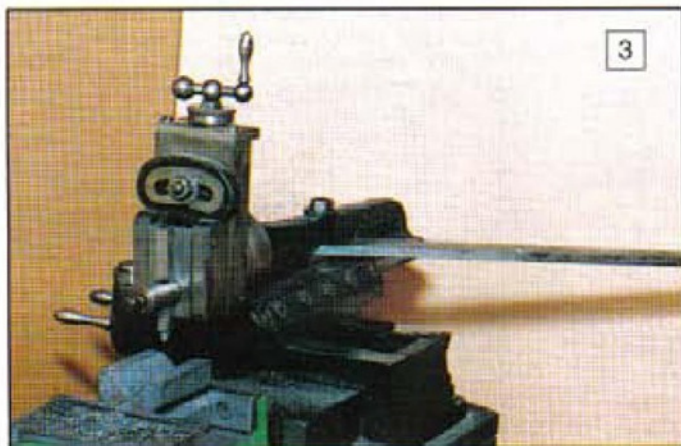
consigned to the corner of the workshop for only occasional use. I decided therefore to proceed with the project in question, a pair of Vee blocks, with the machine in its present state, making what ever provision possible in the set-ups to achieve the best possible accuracy. If, as a result of this project, more projects for the machine looked probable, then refurbishing the machine would be considered again.

## The cutting tools

My approach was to individually machine each Vee block all over to remove the outer skin, taking care to see that the two part finished blocks were similar in size, but not attempting to be exact. Final machining would then be done in pairs to achieve the accuracy required.

I soon began to appreciate the





depths of cut and soon found that a relatively deep cut, around 0.6mm deep, and with a fine feed, around 0.05mm, was easy on the arm, my arm that is. The deep cut got below the skin, but much over 0.05mm feed and the pull required seemed to increase markedly. At this rate of metal removal, operating the machine was quite comfortable, and I am no weight lifter. A session of say

two hours, where some 50% of the time spent was actually machining, was not that demanding. In fact it was probably boredom rather than physical effort that made one take a break after some two hours.

Unfortunately I did not record the time I spent making the Vee blocks, that is machining and setting up, but it was probably around 20 hours, some 10 to 15 hours of this being actually shaping. This may sound a long time, but there are 18 surfaces on a each block making 54 operations in all. If you question this number, it comprises 18 on each block done singularly making 36 operations, and a further 18 when they are machined in pairs. Some 10 to 15 minutes per face seemed about the time and this equates quite closely to my figure of 10 to 15 hours actual machining. It was my first attempt at using a shaper in this way and some improvement on these times might be expected on a future occasion.

The other tool in **photo 1** is a standard lathe parting tool, although this one is carbide tipped, the round nose tool is made from high speed steel. This tool was used to machine the slot in the base of the Vee and the larger slot in the side to take the ears on the clamp. In the case of the slot in the base of the Vee, this was made to the width of the parting tool. It was impossible to take a cut other than for the full width of the parting tool, around 2.5 mm. At this width the machine required quite a hard pull, so depth of cut each time had to be limited to around 0.02mm. This would be hard work if much like this had to be done, but was tolerable in this case.

## The design

The slots along the side for the clamp were intended to be a Vee formation, rather like smaller versions of the Vees formed on the top and bottom. No doubt they are intended to be used as smaller Vees in the same way as the larger ones on the other two faces. This arrangement can be seen in **figs. 1 & 2** which are copies of the casting supplier's drawings, in this case with thanks to The College Engineering Supply. The Vee slots in the side can also be seen in **photo 5**, which shows the casting prior to machining. I decided, however, to create rectangular slots for the clamp to fit into, the amount of metal on both the Vee block and the clamp made this easily possible. **Photo 2** should make this easy to understand. Taking this approach not only created a block more in line with what I consider to be the preferred design, but more importantly as far as this article is concerned, created another form of machining operation.

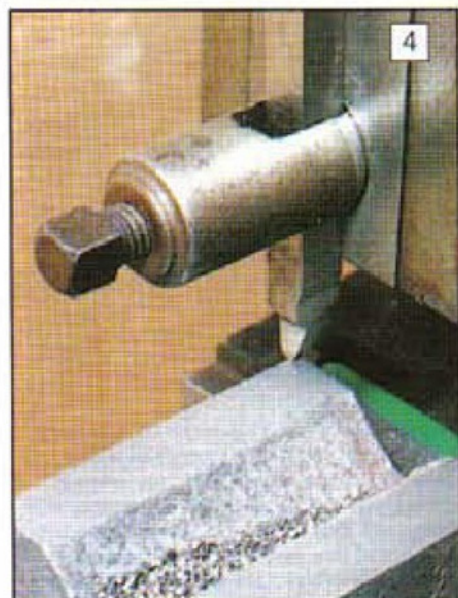
The parting off tool was also used for these larger slots, but as the cast-in groove was of triangular section, it was possible to step the cutter down the side of the Vee, thereby limiting the width of cut for all but the finishing of the bottom of the groove at one end. This operation was therefore much easier on the arm than was the slot in the bottom of the Vees.

## THE MACHINING OPERATIONS

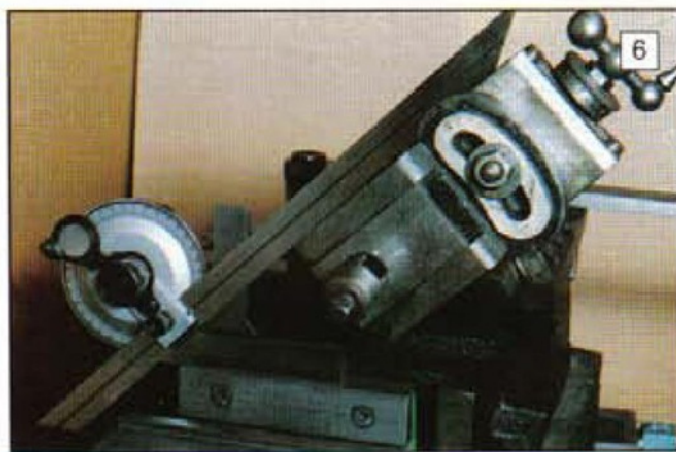
### The outer surfaces

**Photo 3** shows the machine set-up with vice for machining the casting individually. The vice was that featured in issue 23, page 50, being made from a very light duty drilling vice. It proved to be more than adequate for the task, and while machining against the moving jaw would appear to be less than ideal, it is obvious that the vice cannot be rotated through 180 degrees. **Photo 4** shows the first operation in close-up, being the machining of two faces on the top of the Vee block. The block was then rotated so that the already machined surfaces were in contact with the bed of the vice and the reverse side machined in a similar manner. Even at this early stage the quality of the finish

achievable when compared say to a milled surface was very favourable. Sides 3 and 4 were now machined in the same way, but ensuring the surfaces were at 90deg. to each other by setting up side 3 using a square as in **photo 5**. The ends were now similarly machined, again using a square, as in **photo 5**, to set up the first end.



situation of being able to use tools that were initially intended for use on the lathe. I selected a round nose tool with a top rake suitable for turning mild steel, taking this straight from the four way tool post on my lathe. It had been used for some time, but was still reasonably sharp and I used it as it was. This tool can be seen in **photo 1**. I experimented with varying widths and







## The Vees

The slide was then set up, again using the bevel protractor, and the left hand side machined as in **photo 8**. In fact, the left hand side could have been machined with sufficient accuracy by rotating the Vee block and machining it with the slide still set as in **Photo 7**. However, the method was chosen to illustrate how the clapper box has to be swung left, as in **Photo 7**, and right, as in **photo 8**, to ensure that the tool lift gives the desired clearance on the return stroke.

The tool was now changed for the parting tool and the grooves cut as illustrated in photos 9 and 10. As stated earlier, cutting the groove in the bottom of the Vee required a substantial pull, at least by my strength level. Depth of cut

## FINAL MACHINING

First, the angle had to be set to run parallel to the stroke of the ram, and this is seen being positioned in **Photo 11**. Two substantial washers were then bolted down to the table and positioned against

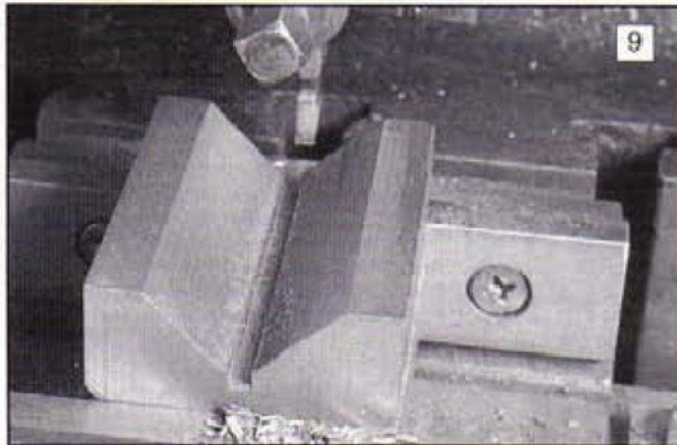
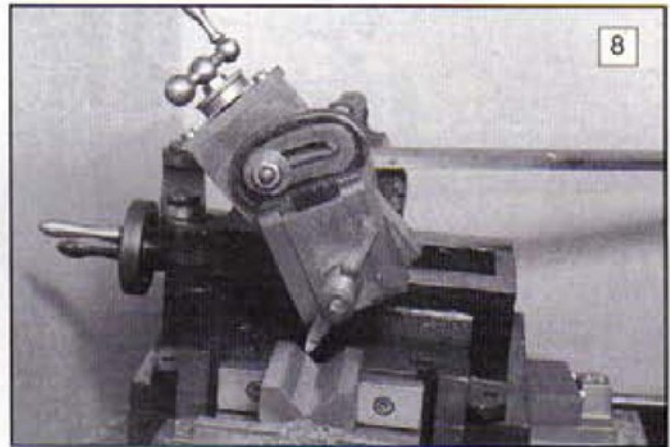
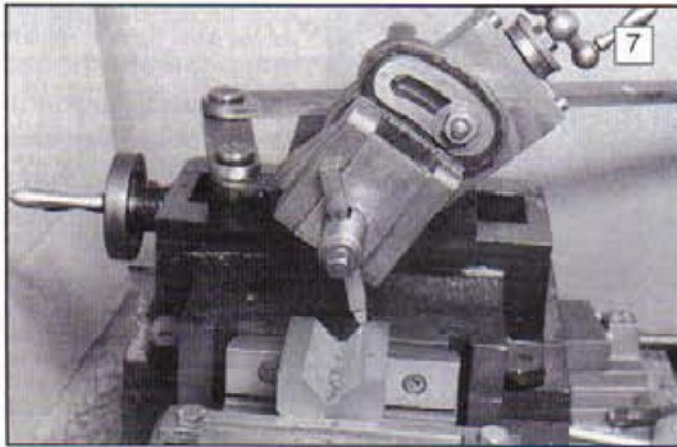


MACHINE ALL OVER

The final stage of establishing this set up was to add a support bar to the angle, positioning this parallel to the ram movement. This can be seen being tested for position in **Photo 13**.

The down feed slide was now set at 45deg., again using the universal bevel protractor, and the first side of the Vee machined as in **Photo 15**. In this case though, the second side was machined with the slide remaining as set and the blocks rotated. The second side was now machined without moving the cross slide.





thus ensuring that the Vee was central. This also avoided any error due to slightly differing angles if the slide was repositioned.

At first it may be considered that ensuring the Vee is central is not that important. If this is so, consider the blocks resting on their sides, maybe on a machine table or the surface plate, and one block is reversed relative to the other in respect of the manner the blocks were machined, the Vee's will now be at differing heights. If the error is sufficient then it will be spotted and one block can be reversed. As is more likely though, the error will be small and this overlooked with potential problems with the product being made using them.

Finally the slots were machined as in **Photo 16**. Here accuracy is not that crucial, but if the slots are not positioned similarly on either side, the clamp may sit at an angle. I feel the error would have to be quite large to make this a problem. The slots in the bottom of the Vee grooves were not re-machined, as there seemed to be no real need for accuracy in this case.

With the machining complete all corners, except the 135deg. corner between Vee and outer face, were generously deburred using a fine file. This was really more a chamfer of about 0.5mm width.

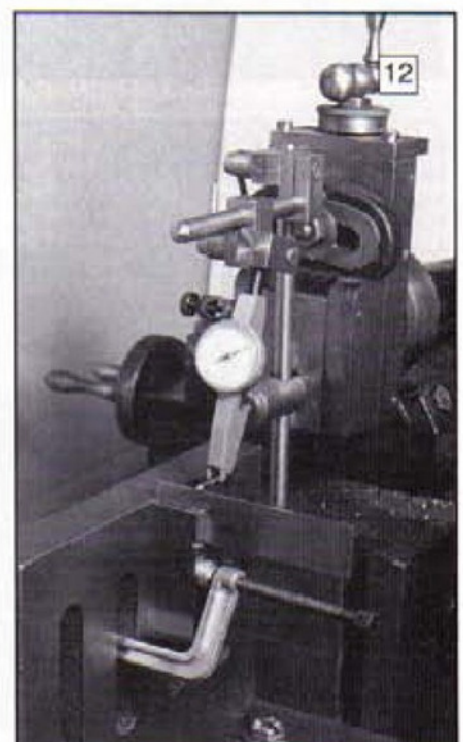
#### Final Result

On completion, the blocks were tested for accuracy and found to be much closer than I had dared to expect. When comparing dimensions, even as pairs, accuracy was better than 0.04mm, better than 0.02 in most cases. This was so except for the width of one block at one end where an error in the

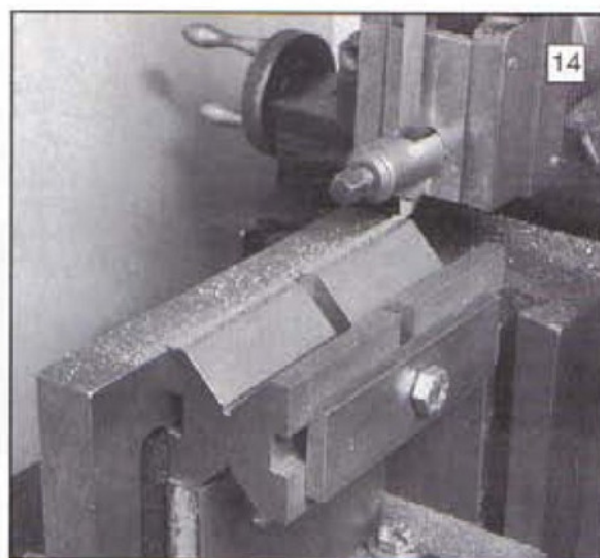
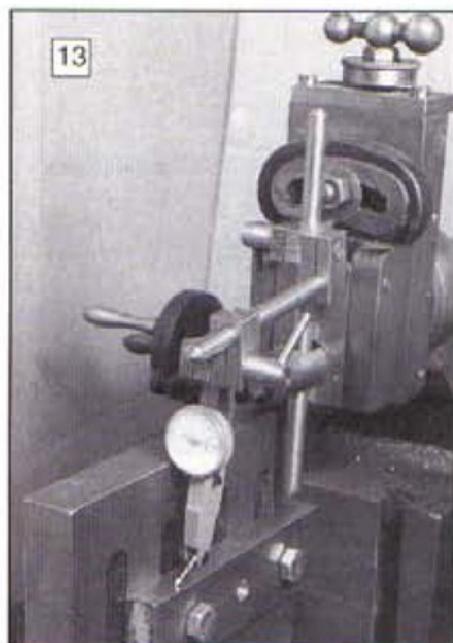
range of 0.075 was evident. This isolated error was almost certainly due to not sitting the block cleanly down on the support bar when being set up for machining. Great care was taken in ensuring the angle plate and support bar were clean between stages and that the blocks were fully in contact with the bar when being clamped in position. Obviously in the case of the one dimension, my care lapsed a little.

After some months the errors show

some sign of worsening, almost certainly due to the castings settling down after the machining had released the remaining stresses. Having said that, the castings were of a very high quality, free of any really hard spots, blow holes etc. They were as a result very easy to machine and the quality of the finish achievable when using a shaper was fully realised. It would though now be preferable to set up the angle again, as in **Photos 11, 12 and 13**,







edge, the carbide tip or maybe differing rake angle? I do not know, though I suspect it was the reduced length cutting edge. The outer end of the casting and the top of the boss were also finished by shaping while mounted in the machine vice, all other faces were finished by hand.

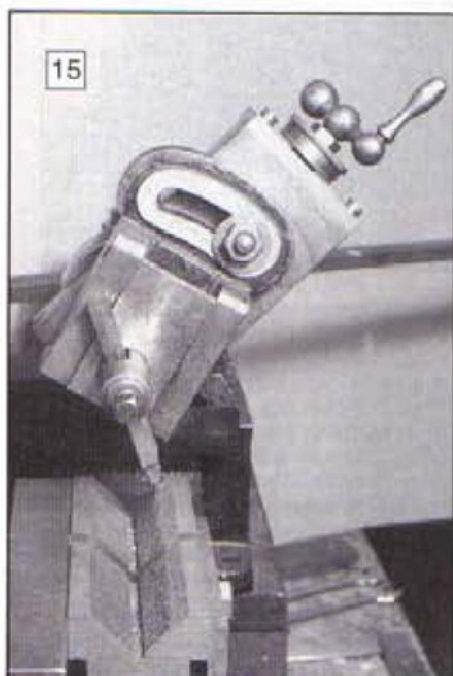
### Hand shaper. A viable proposition?

Well, as a result of this, my first project on this hand shaper, I am totally won over. I will as a result give the machine some attention and provide an adequate mounting, which is essential, as it, with its bench, will easily move around if not firmly anchored.

A powered shaper would be nice as these are one of the few machines that can easily be left to work on their own. However, if space or money is an obstacle, then I can firmly recommend a hand machine, especially if the work being done is of a light nature, such as the castings found in small steam engines and the like.

### Casting supplier

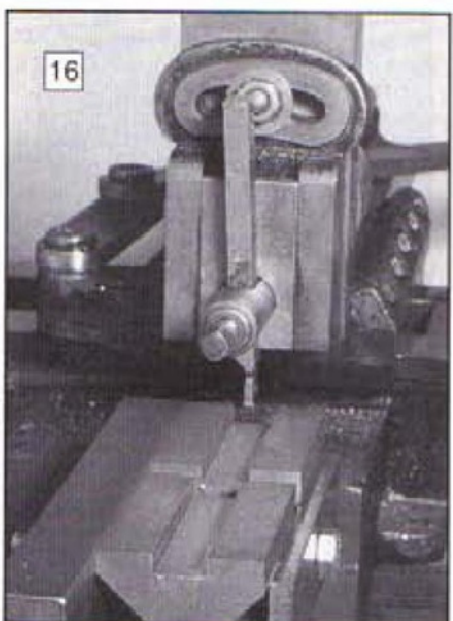
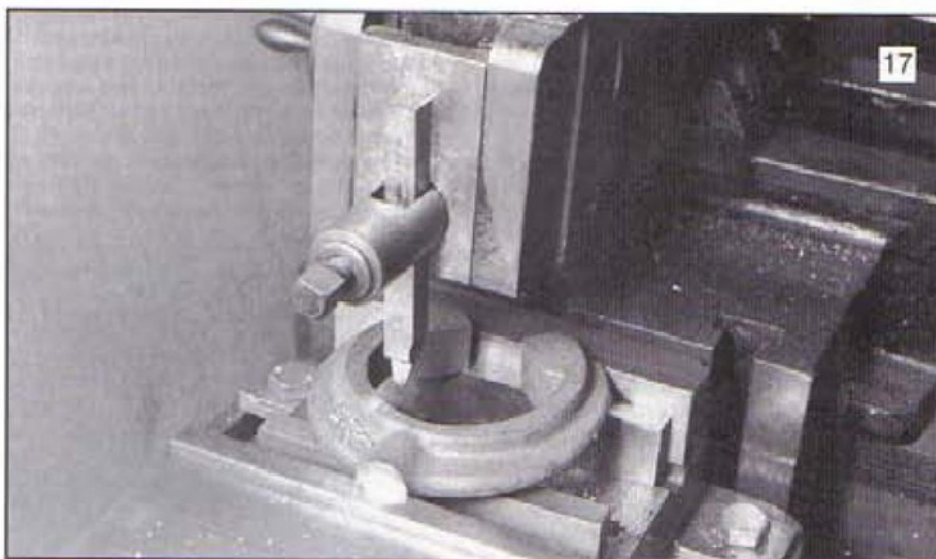
The College Engineering Supply,  
2 Sandy Lane, Codsall,  
Wolverhampton, WV8 1EJ. Tel/Fax.  
01902 842284.



### The clamp

A single clamp casting was supplied and this was made from malleable cast iron. I set out to machine the sides of this using the set-up seen in Photo 17. However, to my surprise, I found the finish being achieved far from satisfactory, showing signs rather like that achieved with vibration on a lathe.

Considering that the round nose tool had by this time taken quite a hammering producing the Vee blocks, I felt that it probably required sharpening. This I



did, finishing it to a very fine edge with a hone. With this done the result showed little if any improvement.

I now considered that it probably did not like the relatively long cutting edge presented to the material by the curvature on the end of the tool and decided therefore to use a lathe knife tool. For this I chose a carbide tipped tool as shown in Photo 18. The difference in the resulting finish was remarkable. It would have been nice to analyse why such a difference, but this could have been time consuming and still may not come up with a definite conclusion. Was it the shorter cutting





Bill Morris shows us how to inspect a lathe to professional standards and gives us some dimensional tolerances against which we can judge a secondhand machine.

Few of us are lucky enough, at least, if we start our hobby early in life, to be able to afford a new lathe as our first lathe, though as cash flow improves as children leave home, we may be able to trade up to a new one in later life. Even new lathes are not free of imperfections, as lathes have to be built to a price, but one can generally rely on a reputable lathe manufacturer not to let any real 'lemons' leave the factory. Some, like Boxford and Wai Yui (Taiwan), provide more-or-less comprehensive inspection certificates with their new lathes, but if you are buying a secondhand lathe you may want to make your own inspection certificate, so this article tells you how to do it. But first, a few general notes about choosing a secondhand lathe.

# LATHE INSPECTION

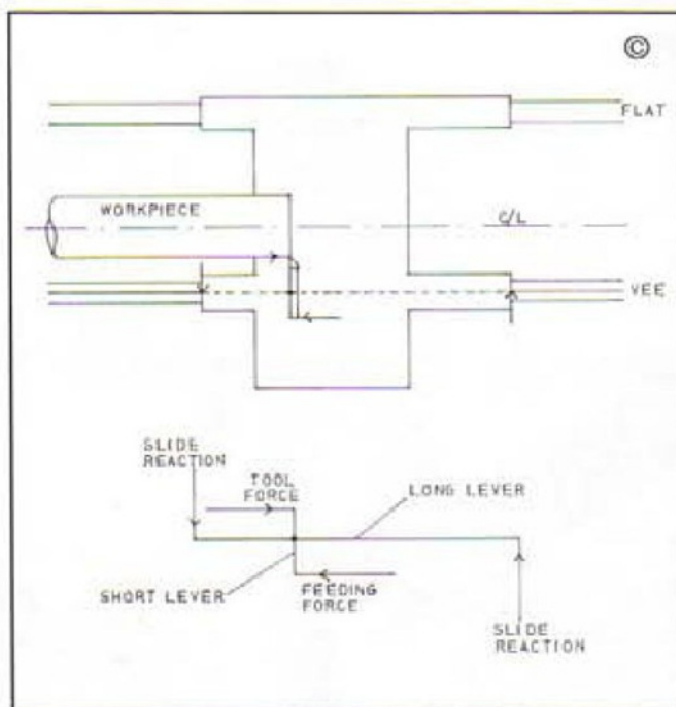
## GENERAL INSPECTION

### The bed

Some things should put you off at once. A bed heavily encrusted with rust is not one which has been lovingly cherished as part of a precision instrument, especially if it is still housed in a dusty, dirty workshop. It may be possible to restore it to something like good condition, and it is possible to be misled into thinking that a light film of rust coated with a dried-up paste of oil and grime is a thick film of rust, so by all means give the rust a scratch with a finger nail. If a shining, hardened and ground bed shows through, all may be well, but be very cautious.

The odd dent or score on the bed should not unduly alarm you. We all make mistakes after all, and I can certainly confess to having watched helplessly as the lathe spindle came to a halt while the chuck carried on spinning, off the too-well-lubricated spindle nose, on to the bed and partly through the lining of the workshop wall. The resulting dent in the bed did not affect the working of the lathe one little bit once the burrs were removed. However, if the bed, particularly at the tailstock end, looks as if it may have been used as an anvil, be on your guard. This is not a pre-loved lathe, but one that has been assaulted and neglected.

Some older lathes made for the amateur market simply had the bed planed without subsequent grinding or hardening. These days, most have the shears ground, but it is still common for a hardened bed to be an optional extra except in East Asian lathes, where it is usually standard. If the bed has a high polish near the headstock end while planer or grinder marks are clearly visible towards the tailstock end, you can expect wear to be present in the bed. Its significance will depend on the form of the shears.



Most modern lathes guide the saddle on an inverted vee at the front and a flat at the rear and this follows the narrow guide principle, in which the guiding planes are long, narrow and placed as close as possible to the line of action of the feeding force. This minimises pressures on the guiding planes as tool forces tend to rotate the saddle about the vertical axis (Fig. 1). If the vee wears, the front of the saddle simply sinks a little as it reaches the area of wear and the tool height falls a little. The error is very small and has a negligible effect on depth of cut. For example, a reduction in tool height of 0.01in. when cutting a 1in. bar results in a change of diameter of only 0.00005in. However, if the bed is twisted along its axis a quite significant error is introduced (Fig. 2), which is proportional to the centre height of the lathe and the sine of the angle of twist.

Flat bed lathes vary in their guiding arrangements. The Myford ML7 series at first guided the saddle on the front of the front shear and rear of the rear shear, while the tailstock was guided on the rear of the front shear and the front of the rear shear. A change was then made to guiding the saddle on the front and rear of the front shear, but this was not a genuine narrow guide, since the wings of the saddle bore

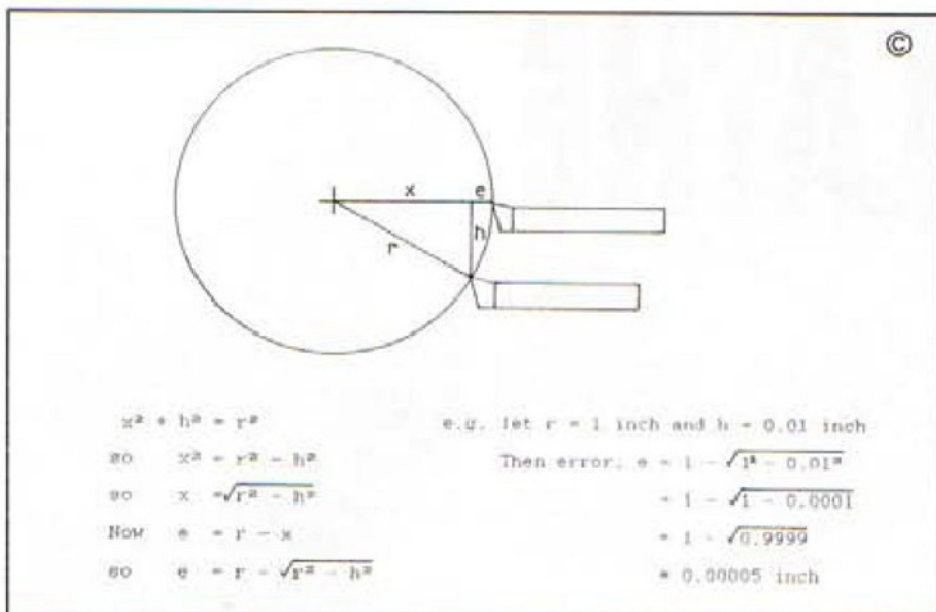
only on the front of the shear. Rapid wear of the saddle guiding surface soon led Myfords to revert to the previous arrangement. The tailstock guiding surfaces should never wear out in normal use unless they are shared with the saddle, as in the Myford ML10, which has a dovetail bed with a rather narrow saddle. A rough and ready check on a flat bed lathe is to wind the saddle over its full length of travel and note whether there is any variation in the force required. If there is, wind it to its slackest part, adjust the saddle gibs and try again. You may then find that it will not traverse the whole length of the bed,

suggesting rather significant wear in the bed. See, too, if you can rotate the saddle about a vertical axis by clamping a bar about 250mm long in the tool post to use as a lever. If you can and the gibs are adjusted, it is likely that the saddle guiding surfaces have worn convex and will need attention. Beware if it feels rather stiff over the whole length. The gibs may have been over tightened to disguise the wear. Adjust the gibs and try again. You can apply a similar test to the tailstock. The tenon between the shears should fit so well that no rotation is possible.

### The headstock

After the bed, which we hope will on later inspection turn out to have flat and straight guiding surfaces, the next most important part of the lathe is the headstock. There are a great variety of bearings used. A simple arrangement which wears well is a hardened and ground steel spindle running directly in the cast iron of the headstock, with rear ball thrust bearing, as in the Myford ML10. Less satisfactory is when the thrust is taken by a collar on the nose end of the spindle bearing against the front of the headstock.





The steel on bronze shell bearings with rear ball thrust bearings of the ML7 series seem to give long service, while Boxford, Southbend and most German and East Asian lathes now fit opposed taper roller bearings, which take care of journal and thrust loads together. Properly rated,

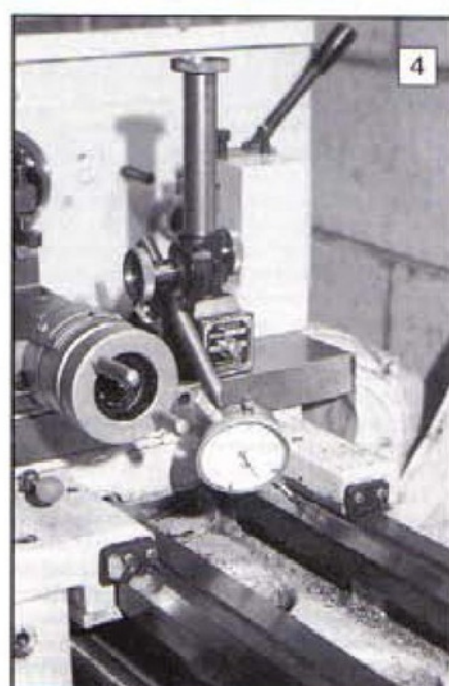
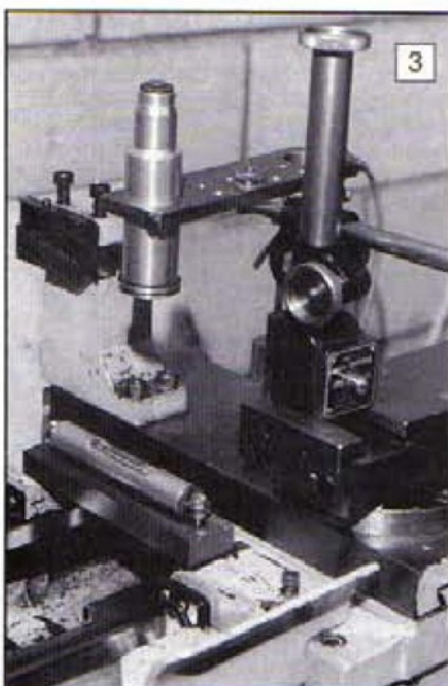
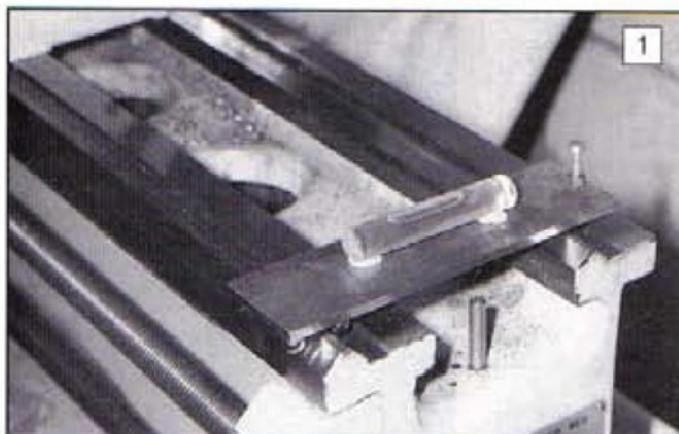
adjusted and lubricated, they should have an indefinite life without requiring further adjustment. Needless to say, the spindle should rotate freely, with no obvious side or end play, though there must clearances or the spindle would not rotate at all. If possible, run the lathe under power to

listen for noises and watch for oil being flung from loose bearings.

A spindle nose which has scored or chipped threads or register is difficult to repair and expensive to replace. If the headstock taper socket is also scored it might well be best to reject the lathe. If, however, the spindle nose and bore are unhardened it may be possible to taper ream the bore and fit a sleeve over the worn areas of the nose prior to re-machining the nose. This is a far from easy task for the relative beginner and is perhaps best avoided.

You should check the back gears for lost or chipped teeth and that it is indeed possible to engage back gear. Back gears missing teeth can have new ones mortised in, using only hand tools, so you need not reject a lathe on this account. More serious are graunching or grating noises when you disengage the bull-wheel pin and try to rotate the pulley on the spindle. This would indicate serious neglect of lubrication in a very important area.

Missing change and tumbler gears can be replaced. Although you should not expect to be able to buy them off the shelf for older lathes, very often gears made for one lathe can be used on another if of the same pitch, by enlarging the bore or bushing a bore that is too large. However, a set of gears for a lathe can cost as much

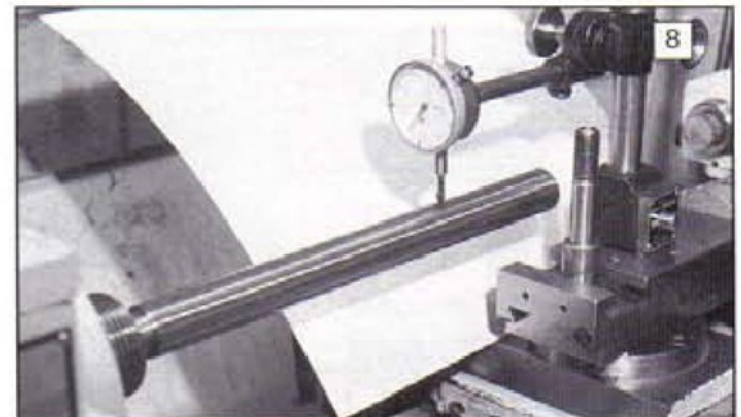
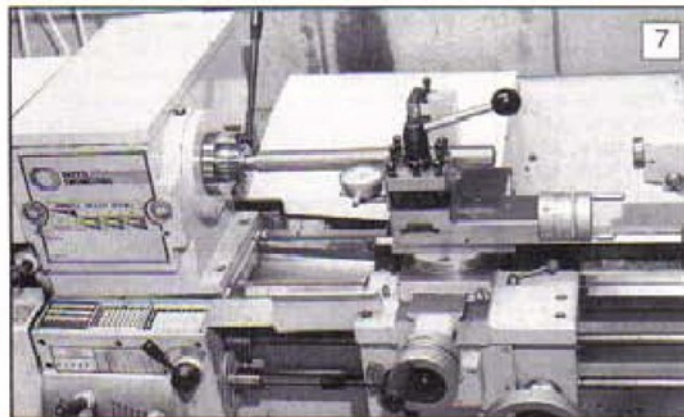
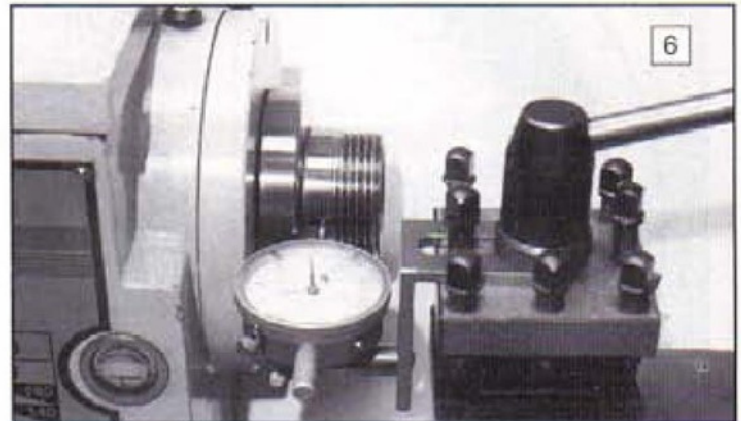
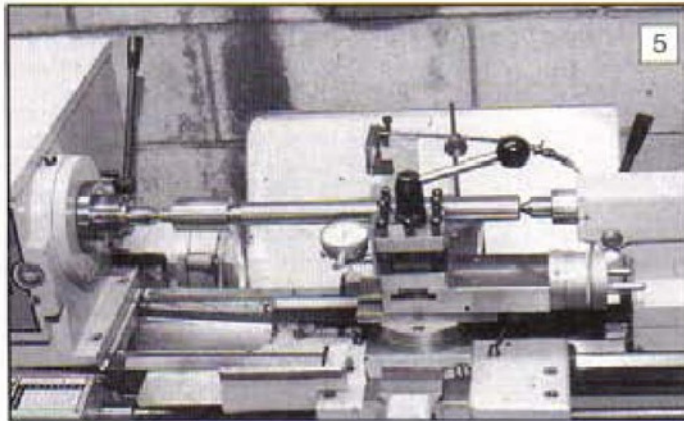


as the secondhand lathe itself and a desire to have a 127 and 120 tooth metric conversion set for one lathe I owned led me eventually to make the gears myself. If the change wheels are present, check that there is a full set and again, take rust and dirt as evidence of general neglect.

### The tailstock

Rust again is the usual enemy of a well fitting tailstock quill. Other than faulty manufacture (which I have seen in one example of a very cheap East Asian lathe), it is difficult to think that normal wear and tear could ever result in poor fit in this area, given that a large, lightly loaded bearing surface always moves slowly and infrequently over another. Nevertheless, users manage to produce badly fitting quills, I assume by using poorly sharpened drills with eccentric points that wobble all over the place. Throw the vendors drill chuck into the socket and use it as a lever to see if you can detect looseness in the fit of the quill. A badly scored taper socket is





not a great problem if the appropriate sized taper reamer can be borrowed, perhaps from a local Model Engineering Club, or the tailstock taken along to a night class and a reamer borrowed from the stores.

### The saddle

A worn saddle can be relatively easily renovated, as can ill fitting feed screws and nuts, so that obvious deficiencies, like loose-fitting slides that cannot be got to move smoothly over their whole travel, should not cause too much gloom. However, cracked or broken slides will need to be replaced at the cost of at the very least a lot of time with a milling machine or shaper, all when you are just trying to learn how to get the best out of your new(ish) lathe. Broken tee slots indicate an unloved lathe or, if it has been loved, the lover has been careless of the lathe's feelings. Dents,

pits and scores in the topslide should not discourage you too much.

### The leadscrew

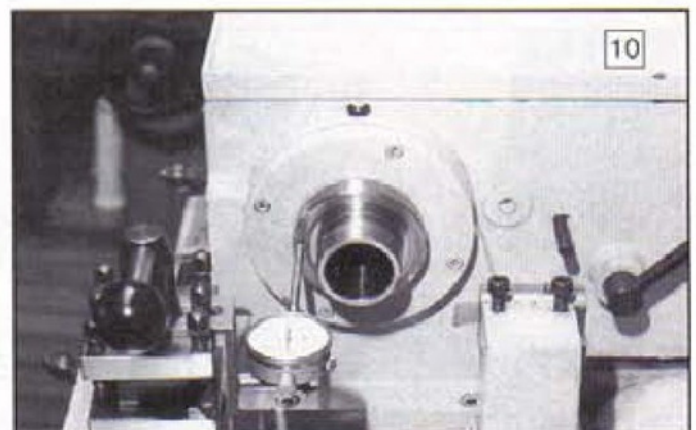
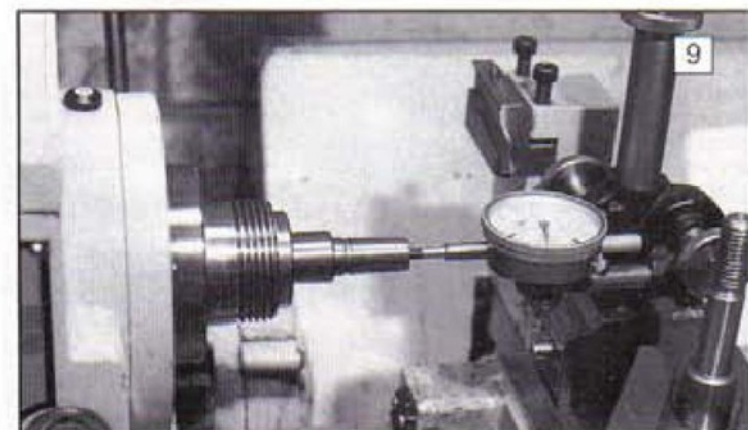
If the lathe is one that relies on the leadscrew rather than rack and pinion to traverse the saddle, it is very likely that it will be worn at the headstock end and the clasp nut is also likely to be worn, so that accurate screwcutting will be out of the question. However, few amateurs go in for instrument or gauge making, where screw pitch can be important, or are likely to require the class of fit demanded by highly stressed bolts and nuts, so a worn lead screw is a minor deficiency for most of us. In any case, as your skills improve, you may be able to make a replacement lead screw if you can get access to a larger lathe and, with a little ingenuity and patience, half-nuts can be resurrected. A bent leadscrew, however, is difficult to

straighten and begs the question of how it got in that state. There will be an unworn bit of lead screw at the tailstock end that has never known the half-nuts' embrace, so that with the aid of a magnifying glass you can make an informal comparison with the rest of the leadscrew.

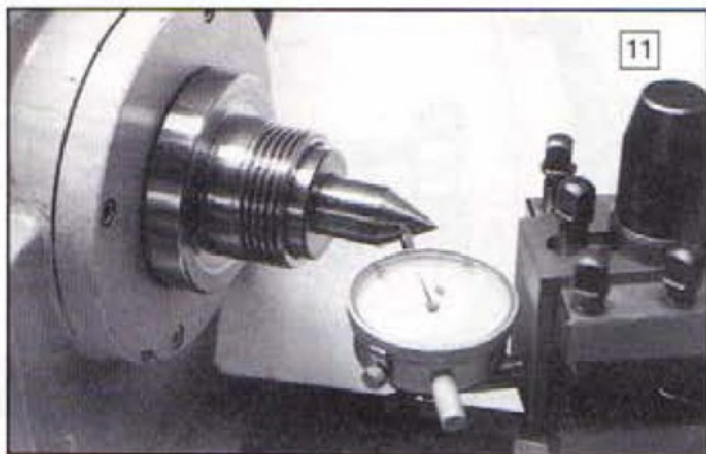
## FORMAL INSPECTION

### Alignment

If by this stage you have not rejected the lathe and the prospective seller is not too impatient, you can think about more formal inspection, but before you can proceed, it is important that the lathe bed is properly aligned. I dealt with this at some length in M.E.W. for February/March 1992, Issue 9. In summary, the lathe has to be attached to its stand or bench in such a way that the







comes in. This should have a sensitivity of about 15 seconds per 2.5mm division and the base must have a flat bottom, but nothing else matters much. I miss no opportunity to practise scraping and scraped the bottom of the level seen in Photo 2. Though often described as a black art, scraping flat surfaces really just needs a lot of practise and when you can get at least 25 evenly spaced spots in a 25mm square, you will be doing very well. If the lathe has a flat bed, then you simply place the level at right angles across the bed at one end and then at the other. If the level reads the same at both ends of

holding down bolts, until the deviation is within this limit, bearing in mind that the bubble of a very sensitive level takes a long time, over a minute, to come to rest. For a bed with Vees and flats, you need to make a fixture like that shown in **Photo 1**. (See also **Fig. 4**). Alternatively, the level may be placed on the saddle itself (**Photo 2**), though the length of the saddle tends to cause an averaging out of any errors.

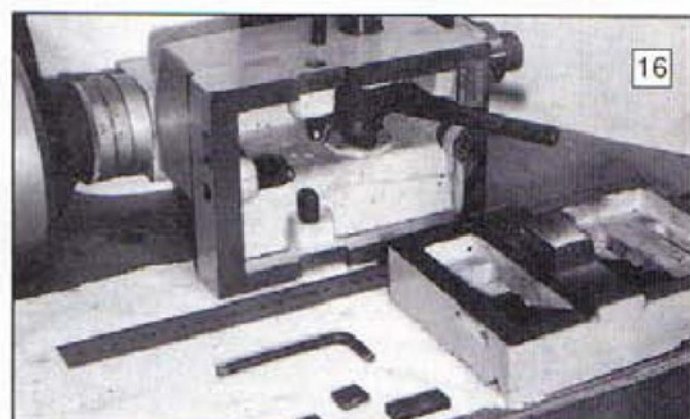
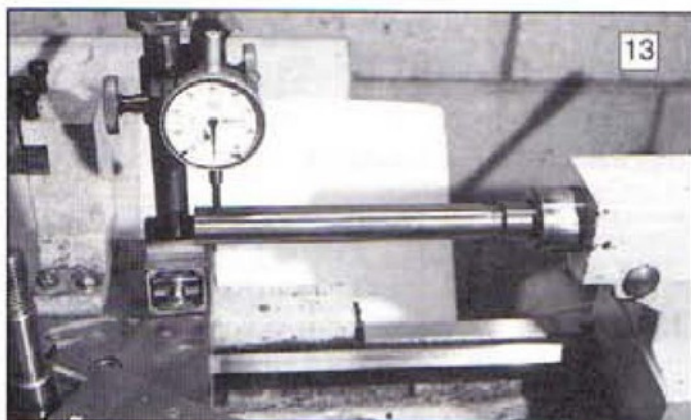
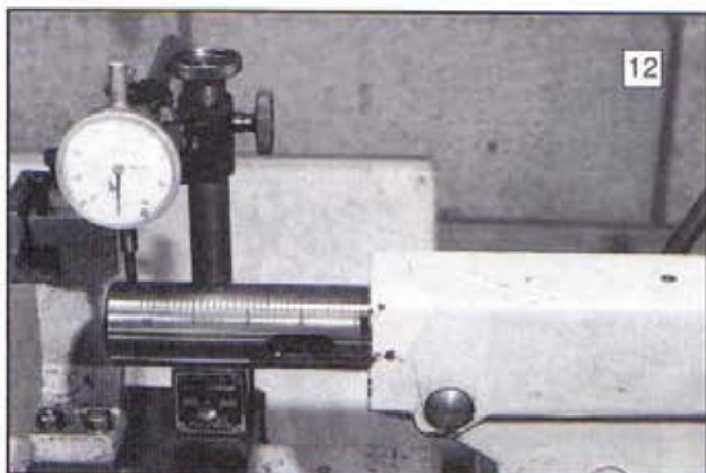
### The bed

Having made sure that the bed is free from wind (twisting), you can then use your level to check straightness and parallelism of the saddle ways in the horizontal plane. Again, on a flat bed lathe the procedure is simple: you set the level accurately along one way and then the other at various points. There should be no more than about 10 seconds deviation along each shear or between shears at any given point, and what deviation there is should indicate that the bed is convex upwards. It is difficult to do this test on a vee without making a special vee base for the level, itself a difficult task, and you will have to content yourself with setting the level across the cross slide and moving the saddle.

You can improve the sensitivity of the longitudinal measurement by making an auxiliary short base for your level as shown in **Photo 3** (**Fig. 5**). The drawing shows that the base has two transverse feet whose centres are 34.4mm apart and a fence (which could simply be two screw heads) to maintain the longitudinal alignment of the level. Trigonometry shows that if one foot is 0.01mm higher than the

bed is not twisted by holding down forces or bits and pieces of the lathe, like motors, cantilevered off the back of the headstock. This is where a sensitive spirit level vial

the bed, then the bed is not twisted. The permissible deviation for a precision lathe is about 10 seconds. Make appropriate adjustments to the





other, the base will be inclined at an angle of 1 minute. You mark the bed of the lathe at 34.4mm intervals (35mm is quite near enough), step the level along, note the bubble displacement from one step to the next, convert it into vertical difference of the feet and thus construct a cumulative graph of the bed contour as shown in Fig. 6, which represents the first 400mm of my lathe from the headstock end. You can see that the bed is straight for the first 5 steps, has a bend and then remains straight thereafter. This allowed me to discover that the removable gap piece fitted incorrectly. Presumably it had been in line with the rest of the bed when it was ground but with a particle of grit between the scraped mating surfaces. At some stage, when replacing it, I must have cleaned this grit away, so that one end is about 0.01mm (4 tenths of a thou) lower than the other. A little kitchen foil soon corrected the discrepancy, which, while probably of little practical significance, provided an interesting diversion for one slightly obsessed with understanding the limits of measurement.

Having established that the bed is free from wind and straight within the specified limits, it is as well to check that the slideways of the carriage and tailstock are parallel. This is done by attaching a DTI to the saddle with the plunger bearing on the tailstock ways as shown in **Photo 4**. There should not be more than 0.02mm (0.0008in.) variation as the saddle is traversed along the bed.

Finally in this section, one should check that the saddle moves parallel to the lathe axis in the horizontal plane. This is done by setting a parallel test bar between its centres and traversing a DTI at centre height along the bar (**Photo 5**). Errors can be adjusted at the tailstock end, and if the test bar is not of constant diameter, the variation is allowed for. Obviously, the centres have to be in good order and always subsequently replaced in their respective sockets in the same relative positions, if the parallelism of movement is to be retained. 0.01mm per metre (0.0004in. per 40in.) is the allowable error and is such a difficult condition to achieve that the wise turner tries to avoid disturbing the tailstock alignment once set.

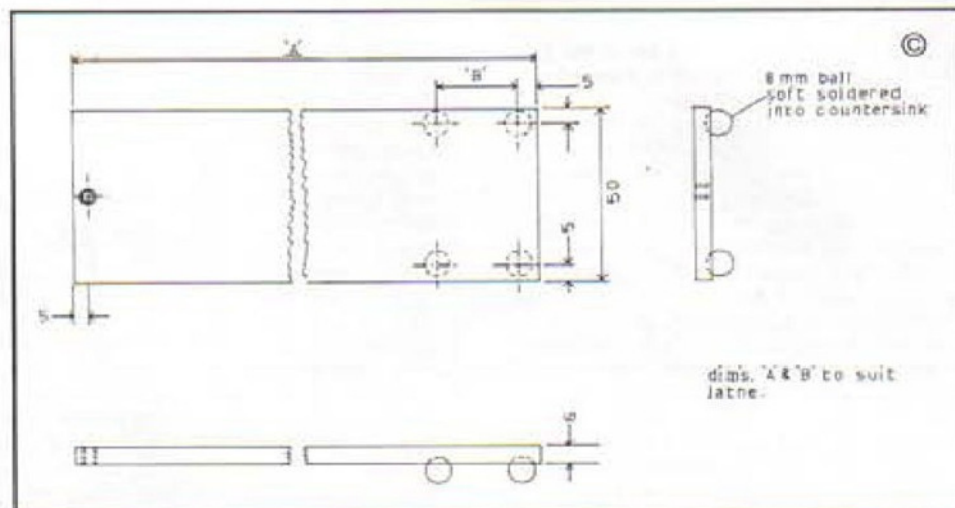
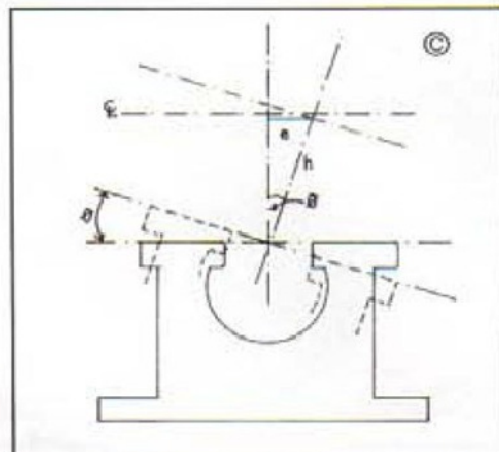
## The spindle

The set-up for checking the run-out of the locating diameter or register of the spindle is shown in **Photo 6**. The spindle is rotated by hand and the maximum permissible variation is 0.01mm (0.0004in.). This is not the same as radial play, which must of course be present for the spindle to rotate, but any movement on applying gentle pressure on the spindle nose towards the DTI plunger should, at least for a roller bearing, be of the order of only a micron or two (0.001 - 0.002mm).

Run-out of the internal taper in the spindle is checked with the test bar, and variation measured as the spindle is rotated, close to the spindle nose and at 300mm from the nose (**Photo 7**). The variation allowed is 0.01mm (0.0004in.) near the nose, and 0.002mm (0.0008in.) at 300mm. Needless to say, the bar taper and the socket must be meticulously clean and free from scores for this test to be meaningful.

The same set-up (**Photo 7**) is used to check that the movement of the saddle is parallel to the axis of the spindle in the horizontal plane, by traversing the saddle. Before you disturb this set-up, use it to set the movement of the top slide exactly parallel with the lathe axis, by traversing the top slide through its full range, adjusting the top slide set over until the DTI reading is constant.

**Photo 8** shows the set-up to check for parallelism in the vertical plane, 0.01mm in 300mm (0.0004in. in 12in.) variation in the upward direction is allowable and the same tolerance directed towards the tool in the horizontal plane. Bear in mind that the bar will sag a little under its own weight, and for a 30mm diameter steel



bar 300mm long, the deflection at the end will amount to 0.007mm or about 0.0003 inch..

While checking spindle parallelism in the vertical plane, the same set-up can be used to check that the top slide moves parallel to the spindle in the vertical plane, by observing the DTI variation as the top slide is traversed throughout its travel. There should be no more than 0.01mm variation per 150mm of travel (0.0004in. per 6in.).

Next comes the test for axial slip of the spindle and **Photo 9** shows the set-up. The DTI plunger axis is set up to coincide with the lathe axis and the ball end of the plunger rests in the centre hole of a taper plug. Applying light pressure on the spindle towards the headstock the DTI variation is read. It is important to realise that axial slip is not the same as axial play but occurs when the planes of the thrust bearing faces are not precisely square to spindle axis. **Fig. 7** shows in an exaggerated form the end result. The permissible error is 0.015mm (0.0006in.).

Once you know what the axial slip is, the run out of the register flange can be checked as in **Photo 10**. Allowing for the axial slip, it should not exceed 0.015mm (0.0006in.).

Finally, the run out of the head centre can be checked as shown in **Photo 11**. Note that I have ground a fine nick on the centre, the taper adaptor sleeve and the tip of the spindle nose, so that the centre always goes in the same relative position to the spindle as when the centre was machined. A run out of 0.015mm (0.0006in.) is permitted, so that when

turning between centres, the tip of the centre could be describing an orbit of this diameter and introducing an error of concentricity between the axis of the centres and the outside of the bar. This is not usually of much practical importance - unless you are making a test bar that will not subsequently be machined on two dead centres.

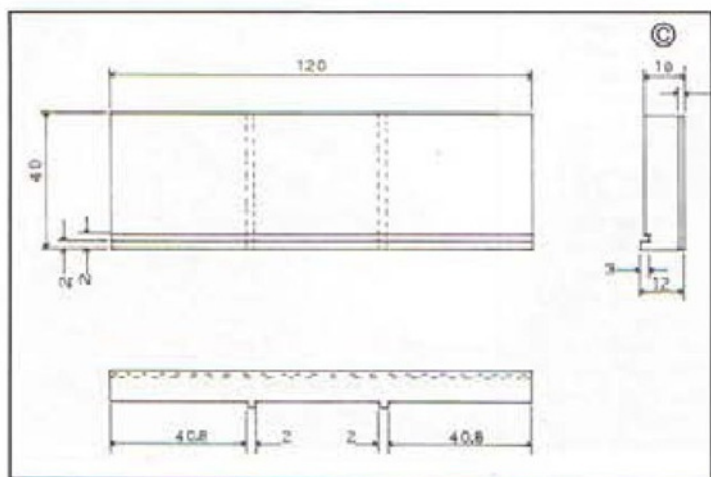
## The tailstock

For all the tailstock checks, the body must be clamped to the bed and the quill locked. The first check is of parallelism of the tailstock quill to the saddle movement. **Photo 12** shows the set-up to check in the vertical plane. The DTI reading is taken with the quill fully extended and then fully retracted. The allowance in the vertical plane is 0.02mm in 150mm (0.0008in. in 6in.) directed upwards. The set-up and method is similar for checking in the horizontal plane when the allowance is less, 0.01mm in 150mm (0.0004in. in 6in.) directed towards the tool point, since the effect of an error on the turned diameter will be greater in this plane.

The test bar is used again to test that the axis of the taper socket in the tailstock quill is parallel in both planes (**Photos 13 & 14**). The permitted run out in the vertical plane is 0.02mm in 300mm (0.0008in. in 12in.) directed upwards, and the same in the horizontal plane, directed towards the tool point.

The test bar can then set-up between the centres and the centres checked for alignment in the vertical plane by





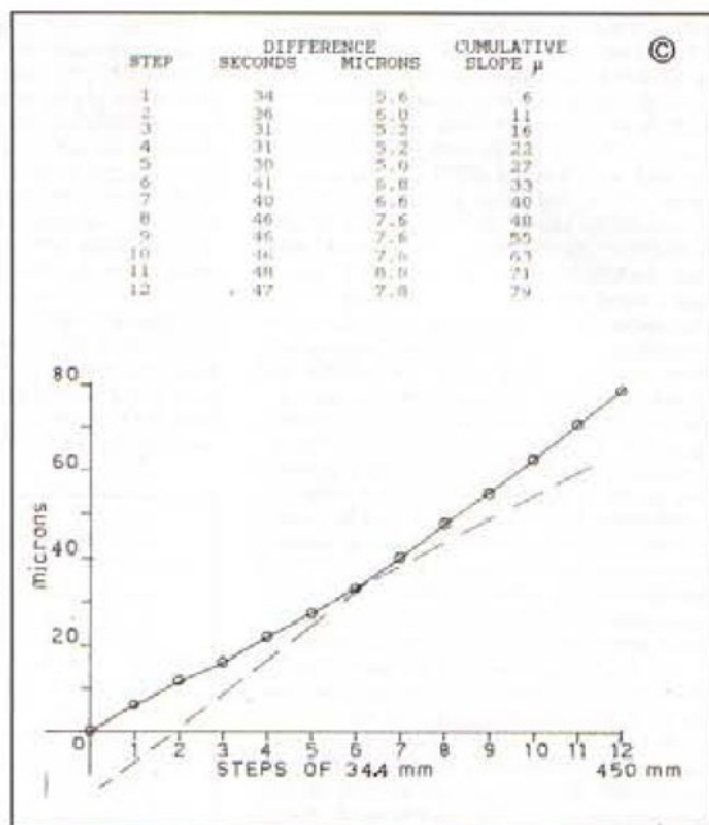
traversing the DTI along the top of the bar (Photo 15). The head centre is allowed to be 0.02mm (0.0008in.) high.

I found a puzzling error of parallelism in the horizontal plane in my tailstock, in that both the quill and the taper were inclined far too much towards the tool point. This suggested that the tenon on the tailstock base was not square to the bed ways, something that seemed highly unlikely given the general quality of the rest of the lathe. Photo 16 shows the source of the problem as well as the internal anatomy of a tailstock (note the cut down champagne cork that lives in the taper socket). The axes of the set-over screws were a little out of alignment with each other and they and the rear locking screw had bitten into the central lug. The result of this was that on tightening the set-over screws, the tailstock rotated a little and, because the tips of the screws were anchored in depressions, the rear screw, whose job in life is to locate the front of the mortise against the front of the tenon, could not do so. I solved the problem by gluing small pieces of hardened gauge plate to the central lug to cover the depressions and prevent new ones forming.

## The cross slide

The essential condition of the cross slide is that its movement should be

square to the spindle axis. Since we now know (hopefully) that the spindle axis is parallel to the bed ways, the condition also amounts to the cross slide ways being square to the bed ways. Photos 17 & 18 show the geometric test set-up. A straight edge is clamped at centre height in the tool post and a DTI clamped to the face plate as shown. The saddle is wound towards the headstock until the DTI plunger bears on the straight edge. The DTI is then rotated by hand, from the front to the back of the straight edge, and the edge adjusted until the DTI reads the same front and back. This establishes that the straight edge is square to the lathe axis. The cross slide is traversed, and if the DTI reading remains constant, the saddle movement is square to the lathe axis. Any error should result in the lathe facing concave only, to a maximum of 0.01mm in 150mm (0.0004in. in 6in.). The line of action of the feeding force on the saddle is generally towards the headstock end of the saddle, so that wear on the saddle guides tends to leave the lathe turning convex. If you find an error in the convex direction, try setting the DTI by



winding the saddle away from the headstock so the direction of the turning couple is reversed. If this tends to correct the error, it suggests that the saddle ways are worn.

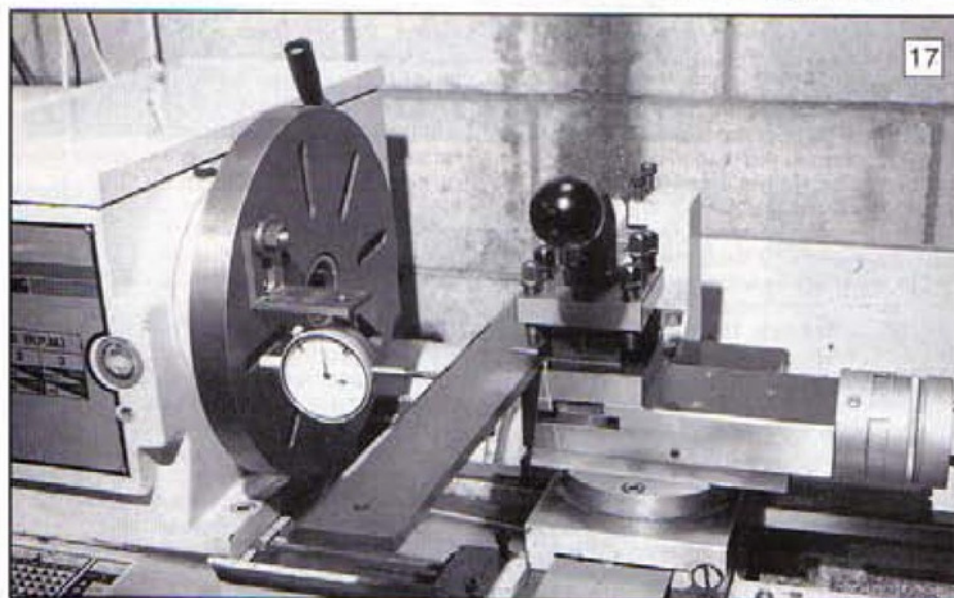
If permitted by the owner, you could also do a turning test by taking a very fine facing skim off the face plate and checking for convexity with a straight edge and feeler gauge. A 250mm diameter plate like the one shown in Photo 19 should not accept a 0.02mm feeler in the middle (which would mean it was too concave), nor should it be possible to trap the centre one of three narrow strips of kitchen foil, one on at each end of the diameter and one in the middle (which would imply that the plate was flat or convex).

## The leadscrew

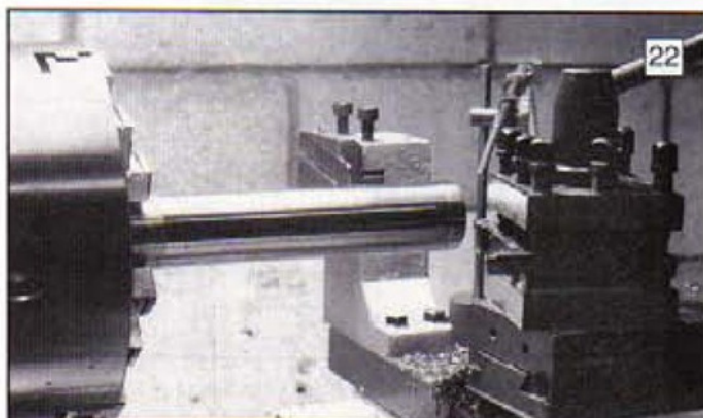
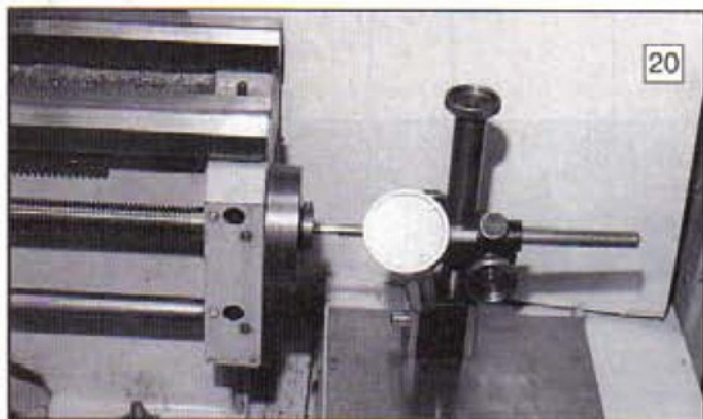
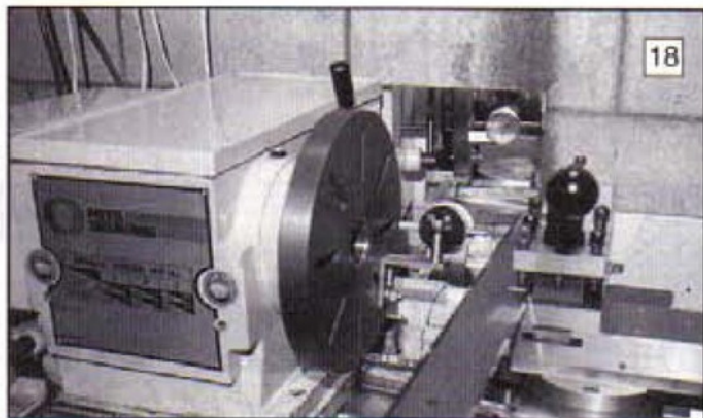
Small errors in the leadscrew do not matter to most amateur turners or, for that matter, to most professionals and in any case, errors in a screw cut by a lathe may be caused by a combination of errors in the tooth form and centring of change wheels, axial slip in lathe spindle and lead screw bearings and only in part by errors in the lead screw itself. However, as it may be of interest to some readers I will briefly cover some of the techniques.

Axial slip of the lead screw is relatively easy to check and Photo 20 shows the set-up, with the ball end of the DTI plunger resting in the centre hole of the lead screw. With the half nuts closed, the leadscrew is rotated by hand and the axial slip should not exceed 0.01mm (0.0004in.).

Further testing really requires length bars, and you may be lucky like me and be able to borrow a set. A bar is laid along the bed against a stop and a DTI zeroed







## TURNING TEST

The ultimate test is a turning test, and the seller may allow you or a more experienced friend to carry one out. You hold a round bar of at least 30mm diameter in the three jaw chuck, free cutting mild steel for preference, and turn two narrow collars about 150mm apart (Photo 22). Then take a very fine

finishing cut over the collars with a sharp and well honed knife tool and measure their diameters. They should be the same if the lathe is turning parallel. The free end should not be larger, as that would imply that the lathe would then free convex. Admittedly, tool forces cause the free end to deflect away from the tool, but with a fine cut the deflection should be under 0.01mm.

## CORRECTABLE ERRORS

Should you be downhearted if your lathe does not measure up to the standards I have given? Certainly not, as they refer to lathes of toolroom precision and even a new lathe made down to an amateur price may have deviations two or three times greater.

As I have implied in the text, some errors turn out to have quite simple solutions and others can be corrected by judicious scraping or shimming, but only if you can detect the source of the error. People have done marvellous work on old and worn lathes by making allowances for their errors, but I personally get much more satisfaction from putting in a bit of time getting a machine tool into proper adjustment so that when I do some work with it I know that the result will come out right first time, within the limits that the machine is capable of.

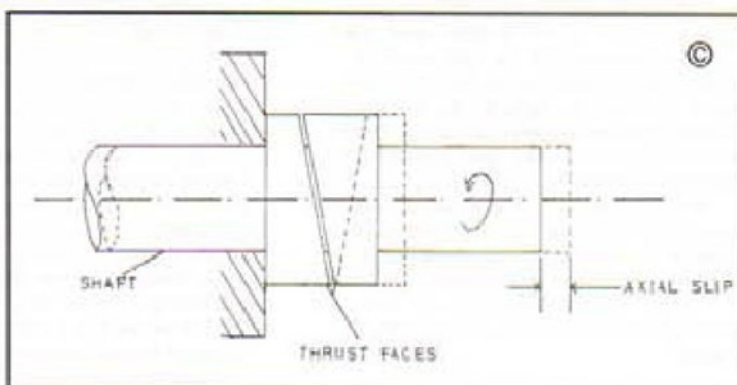
A cracked bed, saddle or headstock casting is probably beyond repair, but nearly everything else can be repaired, adjusted or replaced by the amateur who is prepared patiently to acquire the hand skills of filing and scraping. If you have access to past issues of Model Engineer, the following articles may be useful:

Renovating a lathe bed by F.J. Langfield, No. 3649, 1981

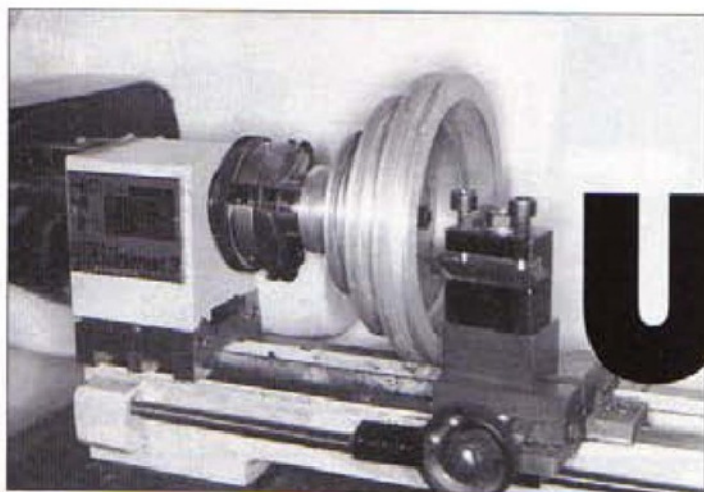
Restoring an old lathe by C.L. Barker, No. 3812, 1987 and

Lathe alignment (in fact about rectifying ML7 saddle wear) by T.D. Walshaw, Nos. 3823 and 3825, 1988.

against one end as shown in Photo 21. The handwheel reading is noted, the bar removed and the saddle traversed by hand until the DTI is again reading zero, this time against the stop. The handwheel reading is again noted and the resulting error calculated. For a precision lathe, it should not exceed 0.03mm per 300mm (0.0012in. per 12in.). An internal micrometer could be used as an adjustable length bar to build up a picture of the errors present in a single turn of the leadscrew, but the errors present in the micrometer may well be nearly of the same order as those in the leadscrew, so that slip gauges are really needed to get a meaningful result. It is possible to include any errors in the gearing between the spindle and the leadscrew by zeroing the DTI and marking the edge of the face plate against a pointer such as the tip of a surface gauge scriber. The length bar is removed and the spindle is then rotated through the calculated number of turns to traverse the saddle the length of the length bar and the error noted from the reading of the DTI.







# A RAISING BLOCK *for the* **UNIMAT** 3

Whatever the size of the lathe, there is always that job which is just too big. Bob Loader sets about increasing the capacity of his Unimat.

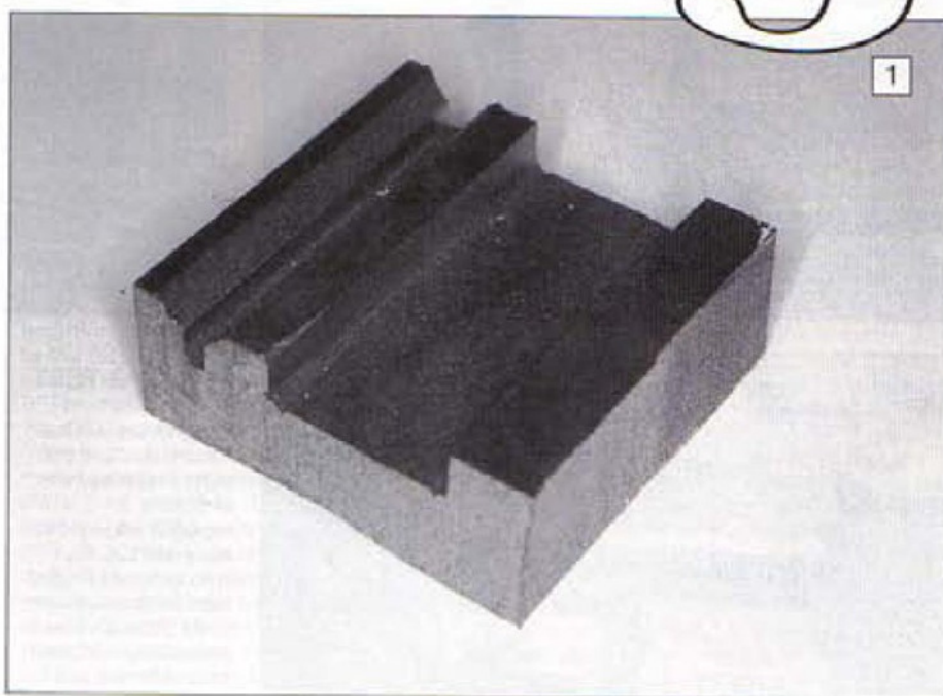
Sometimes a job comes along which is too big in the diameter for the Unimat. The way round this is to increase the swing over the bed, which needs a raising block to lift the headstock. I've been fiddling about with the idea for a couple of years now, and the result is an item which I've cut and filed out of a solid piece of cast iron. **Photo 1** shows progress to date. I don't mind a bit of hand work and filing from time to time, and find it quite enjoyable, but it isn't everybody's cup of tea, so I have re-designed it as a fabrication.

## Some design considerations

Looking at the underside of the tailstock once, when I had to take it off, I found that the Vee and flat which fits the bed is not a continuous shape throughout the length of the casting. The casting is ribbed, so that the shapes are only a proportion of the length - more bearers than anything. When I looked at the headstock, (**photo 2**), to check if it was the same, the bearers were a bit longer, but the casting was made in the same way.

I thought that if the lathe designers could get away with it, then so could I, especially as they used aluminium alloy and I planned to use cast iron or mild steel. My version is a block of cast iron, with three shaped inserts, two as end plates and one in the middle, (**see fig.1**). The inserts would fit the bed, and the other Vee and flat for the headstock to stand on could be added later as separate pieces. This would save an awful lot of machining. If in doubt, fabricate, as Confucius once said.

The most important part of the job was getting the profiles of the Vee and flat right, and I decided to use templates. These could be used, not only for getting the holes for bolts and dowels in the right places, but also for filing jigs for the shapes.

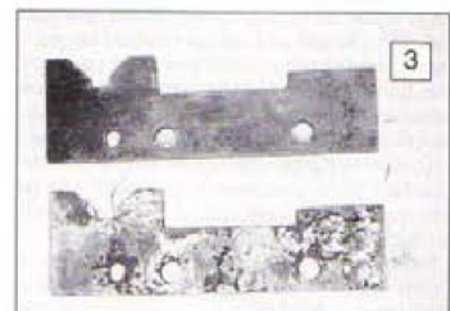


## Templates

**Figure 2** gives the dimensions for the templates, and **photo 3** shows the pair just after case-hardening, the grotty finish being a characteristic of case-hardening. I used mild steel and case-hardened them, but they could be made from gauge plate if it is available. They could also be thicker than mine, which are 3mm, because that is the thickest I can get hot enough with my propane torch.

After filing the two pieces of 60mm x 20mm to length, I marked out one of them, using a large black marker pen, as it dries quickly and is an excellent surface to mark on. The two blanks were accurately clamped together and the dowel holes drilled and reamed. I had some 5/32in. silver steel, so I used that for dowels, but any similar size would do. I used short dowels to locate and small parallel clamps to hold the two together. **Photo 4** shows one side of the Vee being finished. For the accurate filing, I used a piece of square stock clamped to the job in line with the marked line, to act as a fence; when the file just skids, the surface is finished. The clamped fence can be seen in **photo 4**.

Once the profile was as accurate as I





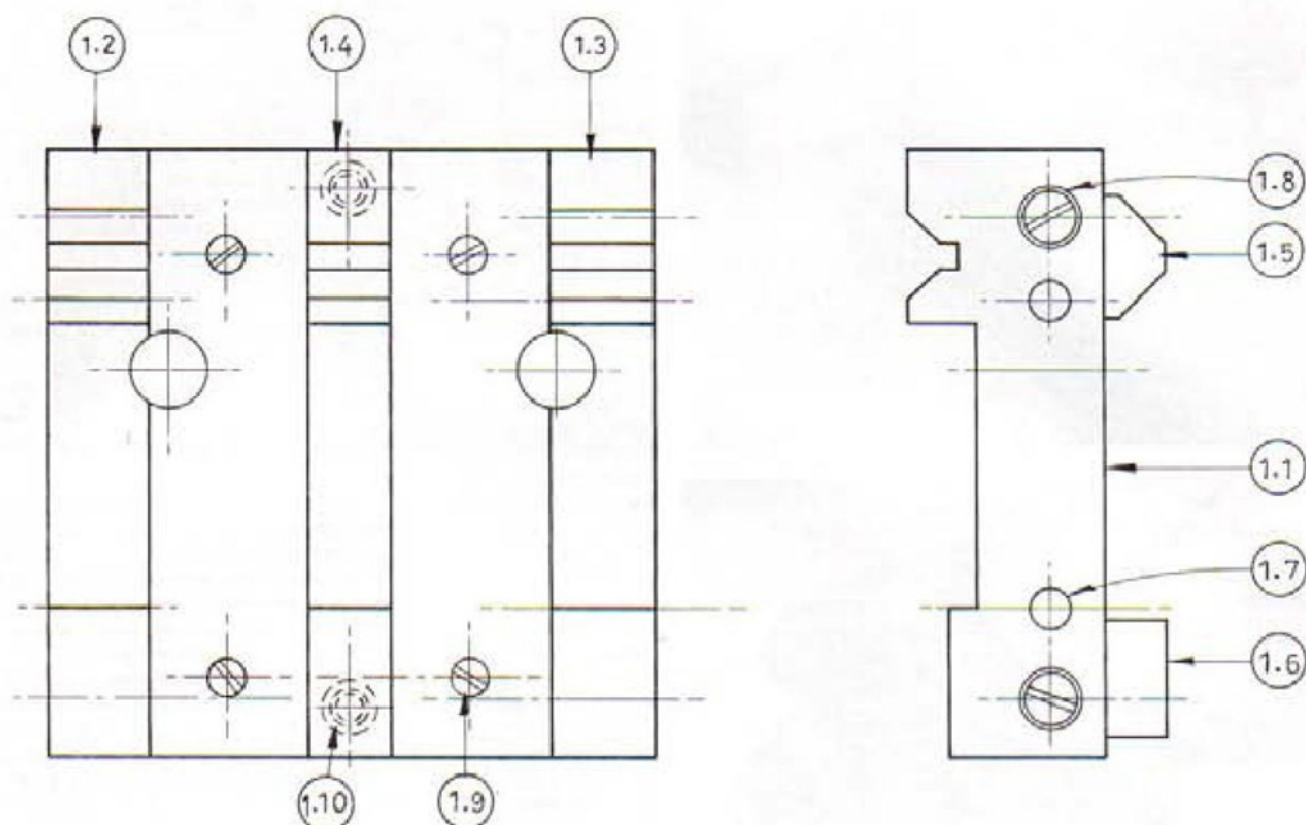
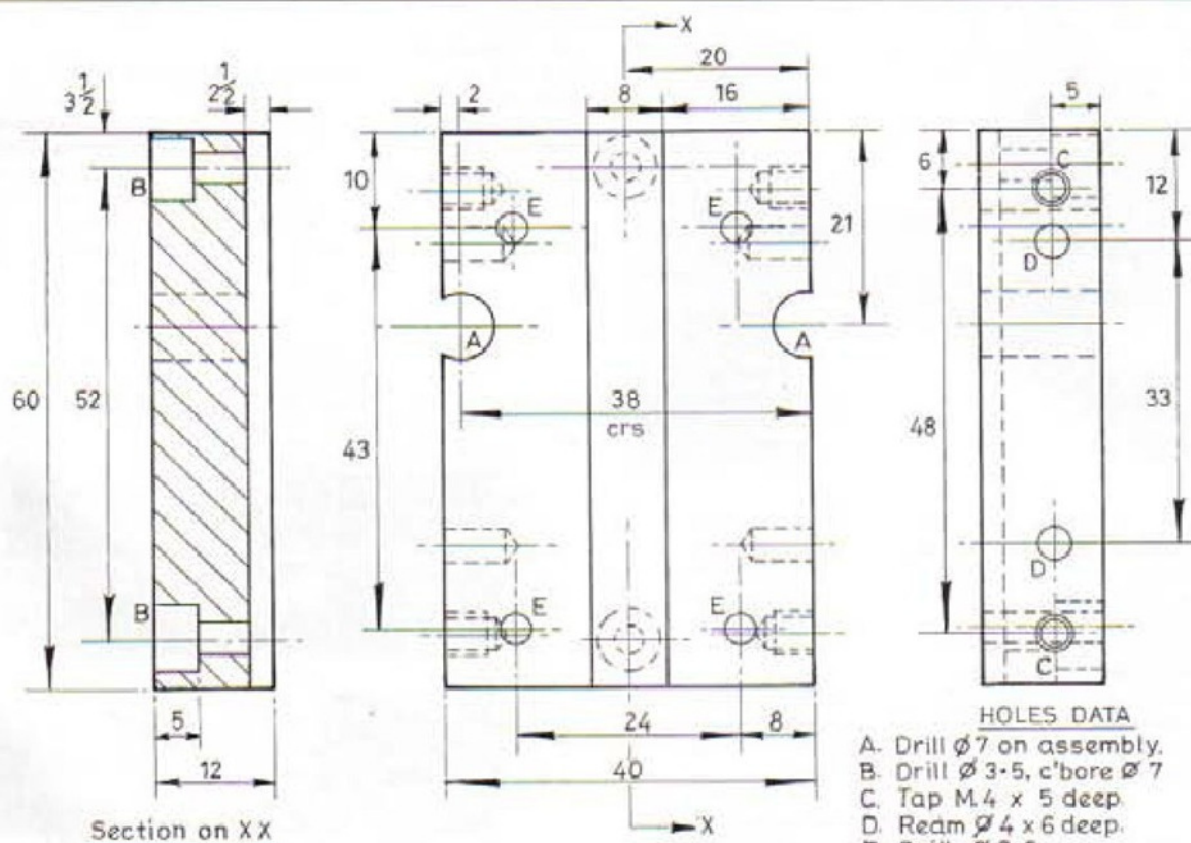


Fig. 1

RAISING BLOCK ASSEMBLY

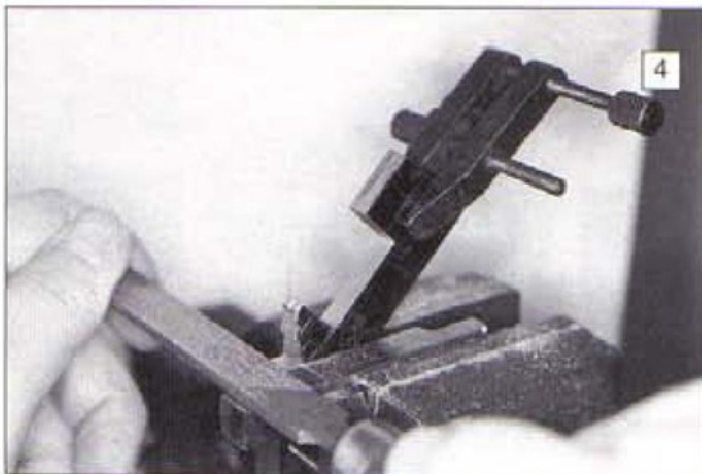


1.1

BLOCK : Cast iron or b.m.s.  
Dimensions in millimetres







compost bag stands on. They are ordinary building bricks and reflect the heat well enough. My propane torch just delivers enough heat to get the templates red-hot. I sprinkled them with Kasenit® while they were red-hot, soaked them for a minute or two and quenched them in cold water. The hardness produced by this method will only give a skin of hard material, but the templates only have to do three profiles and should last.

shows high areas being picked off from the surface of the block, and **photo 6** shows a way of checking the ends for squareness.

An accurate Vee block is used to hold the work upright and it is rubbed on a surface plate which has been blued. With a finished face and edge held in the Vee, the high spots or areas will have a trace of blue. The blue is the shoe polish again, and it doesn't have to be blue, any of the dark colours will do.

When the block was to size and as accurate as I could get it, I put it to one side and did another part. A lot of the drilling is done later.

### End plates (Items 1.2 & 1.3)

I chose 20mm x 10mm stock for these, and the first job was to cut and file them to 60mm long. They were clamped one at a time to one of the templates, lined up, and the dowel holes just spotted through with a  $\frac{5}{32}$ in. drill. The reaming size drill will follow this start. I give no size for the reaming size drill because my views on reaming allowances seem to conflict with most readers.

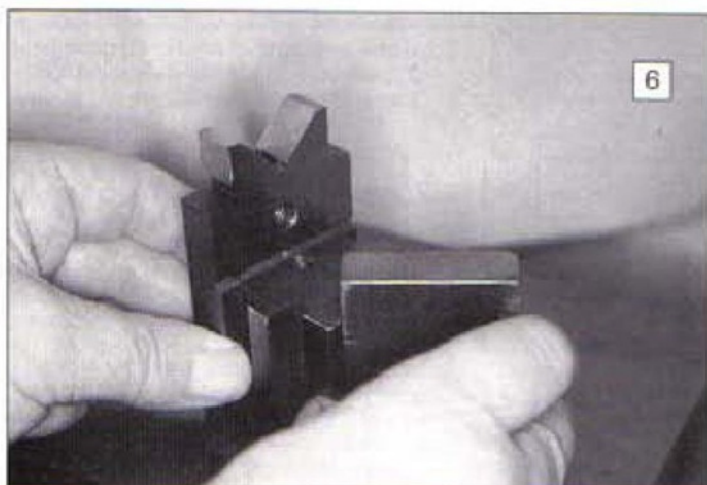
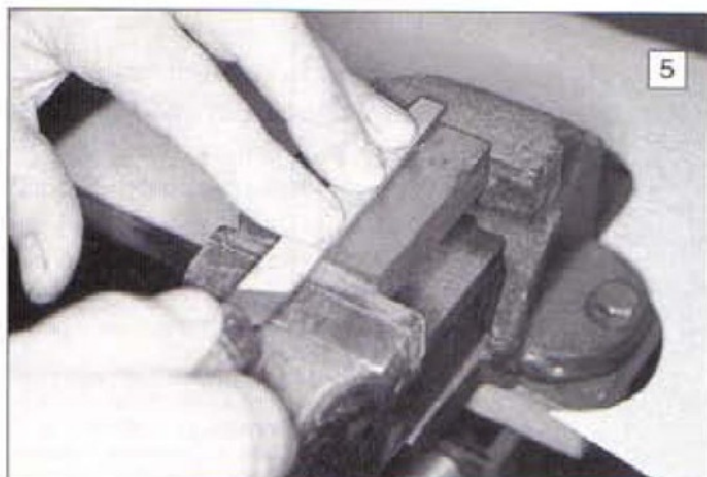
When the holes had been reamed, a couple of  $\frac{5}{32}$ in. dowels were cut, a bit shorter than the width of the plate and the two templates. 15mm was right. The templates then make a sandwich, with the end plate as the filling, all doweled together. With the waste roughly cut with the hacksaw, the shape was filed till the file just rubbed the templates. **Photo 7** shows one end plate complete and the other one sandwiched ready to start filing.

### Centre plate (Item 1.4)

Because the centre plate was smaller in depth than the other two, it was made by lining up the piece of 10mm x 8mm with the top of the Vee, clamping it, and working from there. As long as it stays clamped, once started, it will be the same

### Block (Item 1.1)

With the templates finished, I started the block. It was cut from a cast iron lump, which was the casting for a machine vice jaw. It was hard work, but with high speed steel hacksaw blades and sharp files, cast iron of this grade works well. It is a lot easier to use stock 12mm x 40mm mild steel. I hadn't anything like that, and I don't mind a session of filing occasionally. It gives me the chance to listen to



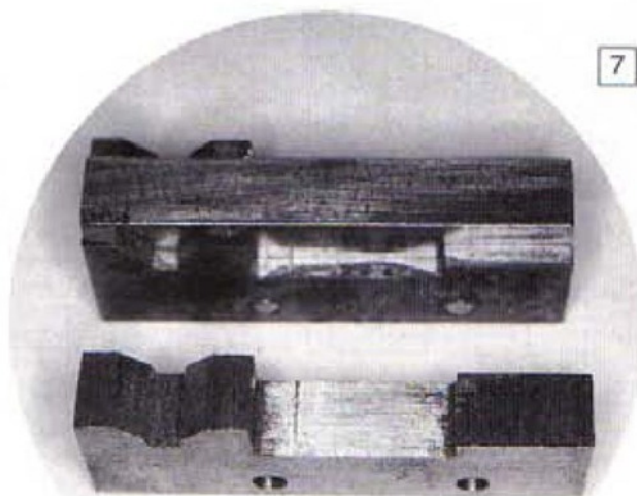
could get it by these methods, I blued the lathe bed and gently rubbed the templates on it, filing off the blue patches. This improved the accuracy and, when I was satisfied with it, I checked it for being parallel. The machined step, where the tailstock clamping plate fits, is a good register to measure from. My engineers' blue was, as it always is, my wife's navy blue shoe polish, permission sought from the owner, of course.

### Case-hardening

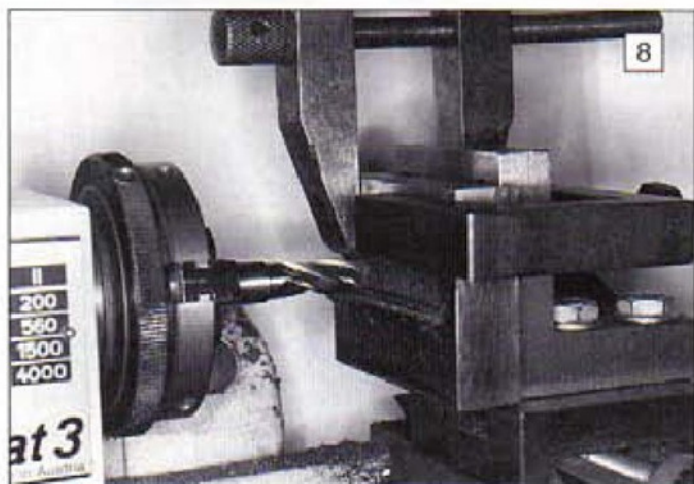
When the templates were finished, I case-hardened them. This is a somewhat primitive process, done in the shed, where I make a hearth with the bricks which the

some favourite tapes, without graunching noises from the machinery. I can catch all the nuances of the music or whatever. I can also pick up all the bits the censor missed in the Goon Shows!

Making the block from scratch is a matter of filing the thickness right first, then an edge square with it, then the opposite edge, and so on. **Photo 5**







to shape as the end plates. Note that I have included a reference dimension for the Vee, measured over a 10mm test bar for each of the plates. It may not be exact, but should be somewhere near the figure given.

When the plates were finished to that stage, they were put to one side to wait while the block was taken a bit further: there would be more work to do on them when they were assembled. At least they would be close to finished profile.

### A little milling

A milled slot in the middle of the base block accepts the centre plate. My method for milling this on the Unimat is my usual one, a small angle plate clamped to the cross-slide. **Photo 8** shows the block being milled. Because the travel is restricted, it wouldn't mill right to the end and the last bit had to be filed. I found that a piece of packing 1mm thick lifted the block off the cross-slide enough to bring the slot near enough centre. The cutters used were a  $\frac{1}{8}$ in. slot drill for roughing and a  $\frac{3}{16}$ in. for finishing. The saddle was locked for each cut and the cross-slide screw tightened a little to put a bit of a drag on it. It didn't stop the lathe making a noise, but it did well. I saw recently, on a television programme, that the technicians making small bits and pieces for the new James Bond film were using a Unimat 3. If it is good enough to make 007's gizmos, it must be well thought of.

### Fitting the end plates

With the slot milled and the end plates and centre plate ready for positioning, it was time to do some drilling. Because my drilling equipment is just the lathe, clamping a deep job like the block is not easy. The solution was to stick the end plates to the block with Loctite 601. I cleaned everything, smeared the end plates with the Loctite, lined them up and clamped them for an hour while I did something else. The Loctite worked well, holding tight for the drilling and reaming of the dowel holes.

The holes marked 'C' in Drawing 1.1 were drilled with the tapping size for M4. They were tapped while still stuck together, through the end plates and into the block. A sharp tap with a hammer handle released the end plates and the

holes shown in Drawings 1.2 and 1.3 were drilled 4.5mm and counterbored 7mm. Be careful to follow the note and counterbore one end plate right-handed and the other one left. If different screw sizes are used, then the size of counterbore may have to be changed. The sizes I've specified are a guide and can be different as long as they do the job.

At this stage, the small clearance holes 'E', Drawing 1.1 can be drilled. They fasten the upper Vee and flat, so they need to be as accurately done as possible. Also the holes 'B' can be drilled and counterbored.

The endplates and centre plate can now be assembled to the block. I did that and checked for parallelism (**photo 9**), which was within 0.05mm, which was acceptable.

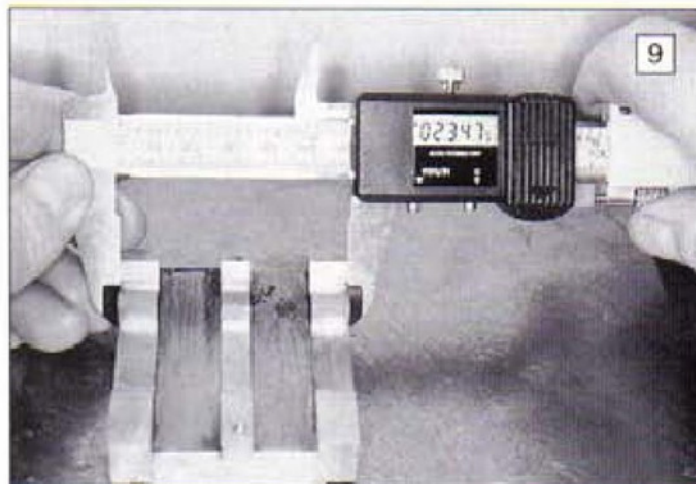
### Finishing the Vees and flats

The profile of the plates had, up till this stage, been reasonably accurately made. To fit really well, there was more work to be done. The lathe bed was blued again and the assembly lightly rubbed along it. The high spots were filed off and the process repeated as often as needed. It is tedious and takes time, but worth doing for as long as it takes to get the blue marking on all the separate surfaces. **Photo 10** shows the filing well underway. The file I used, a three-square Swiss is a good choice because it will bend slightly and has a cutting edge in 3 positions. I put a couple drops of light oil with the shoe polish / engineers' blue to stop it drying out too quickly. The only problem with this was that the filings mixed with the blue and tended to clog the file, so I kept a file card handy.

The alignment of the Vee can be checked with a dial indicator as in **Photo 11**, or by using a Vernier height gauge, (**photo 12**). So far, so good, the ground work had been done; there were a few more components to make.

### Upper Vee (Item 1.5)

This was cut from 12mm square bright mild steel. It made a Vee about 16.5mm at the base, which was plenty wide enough. It is a good idea to normalise the bar before cutting because the stresses put in by the cold rolling or drawing will be enough to make it bend when half of it is cut away. Normalising is an easy process: the material is heated to bright red and



allowed to cool at its own rate. The book insists that it must be kept out of draughts while cooling; I've never found it makes any difference, although I have never done it in a howling gale. My torch will not get that size of material hot enough, so I had to bend it straight afterwards.

Whichever way it is done, it should be left in the lump for as long as possible, so that it can be held. **Photo 13** shows the check for the base of the Vee being parallel.

### Fitting the upper Vee

It is essential that the upper Vee lines up with the lower one, not an easy task. My way of doing it used the templates again and the set-up is shown in **photo 14**. The templates are clamped across the upper Vee and block and the assembly lined up by pushing it up against an accurate register, in this case the base of a ground Vee block, with a piece of 6mm square steel supporting where the flat will be. When everything was clamped tight, the holes for the screws were spotted through. I used my Black and Decker drill. A spotting punch would do just as well.

Drilling the holes in the Vee needs a bit of fiddling about. I clamped a Vee block to the faceplate on the Unimat and put the Vee in that. Two hands are just about enough, three would be better. The holes can be drilled right through, but would look a bit unsightly, so I drilled them to give a full thread 4mm deep. The screws are only small and will locate and clamp adequately.

### Upper flat (Item 1.6)

This is an easier job than the Vee. It is stock 12mm x 6mm steel, and it was the right height to bring the block level. The 6BA tapped holes can go right through because it is not quite thick enough to get a blind hole in successfully. When the Vee and flat were assembled, I checked the Vee for alignment, (**photo 15**). The dial indicator stylus is bearing on the flank of the Vee, the assembly being slid to and fro.

The last job on the complete block is to drill the two 7mm holes marked 'A' on Drawing 1.1. 7mm is an arbitrary size and they may need enlarging or slotting on final assembly. They are only to let the 6mm bolts which hold the headstock on



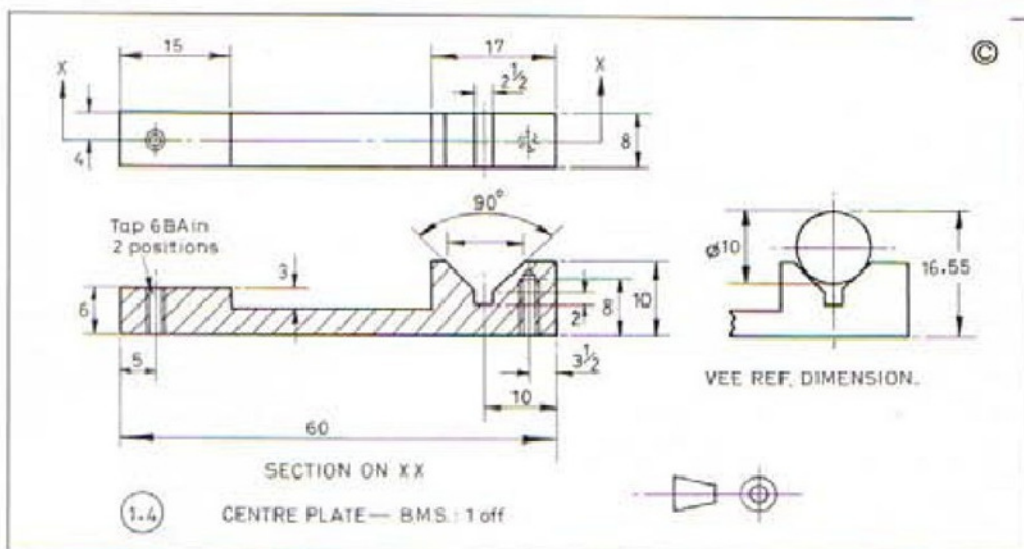
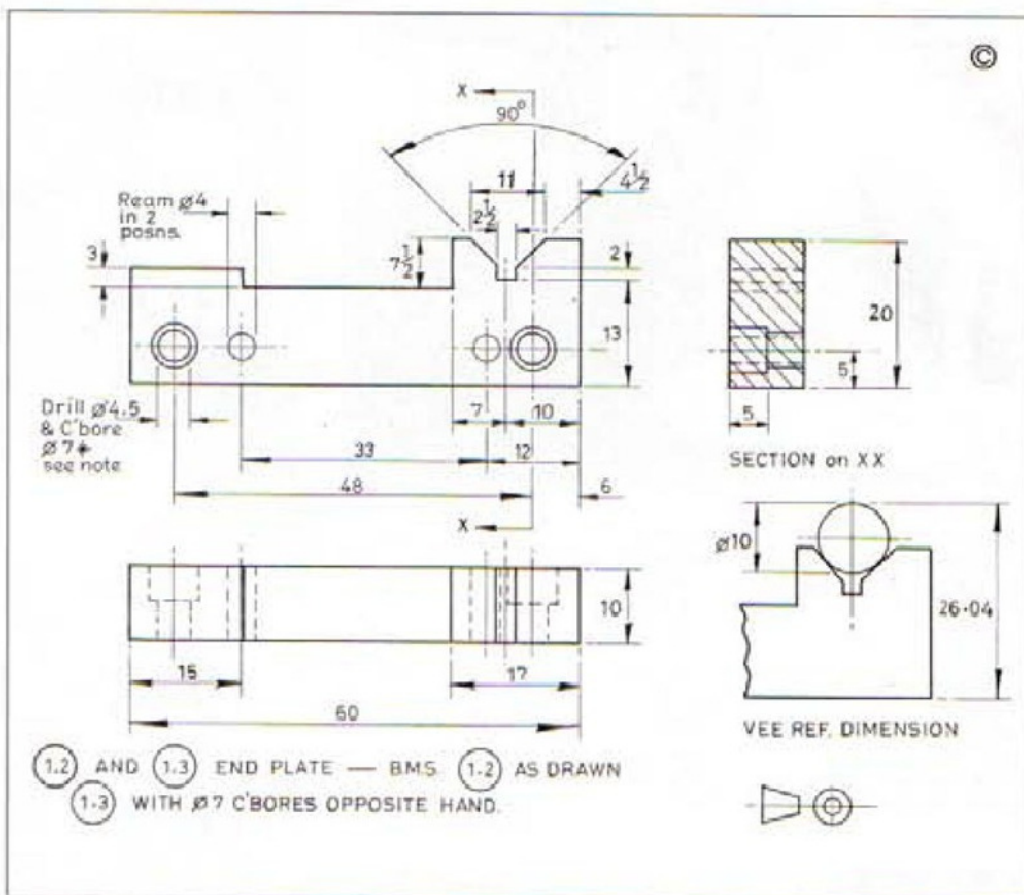
the bed go through. I did the job by stages, drilling a pilot hole first, then progressively opening up.

**photo 16** shows the raising block in position. It lifts the headstock enough to give a swing of 140mm diameter over the bed.

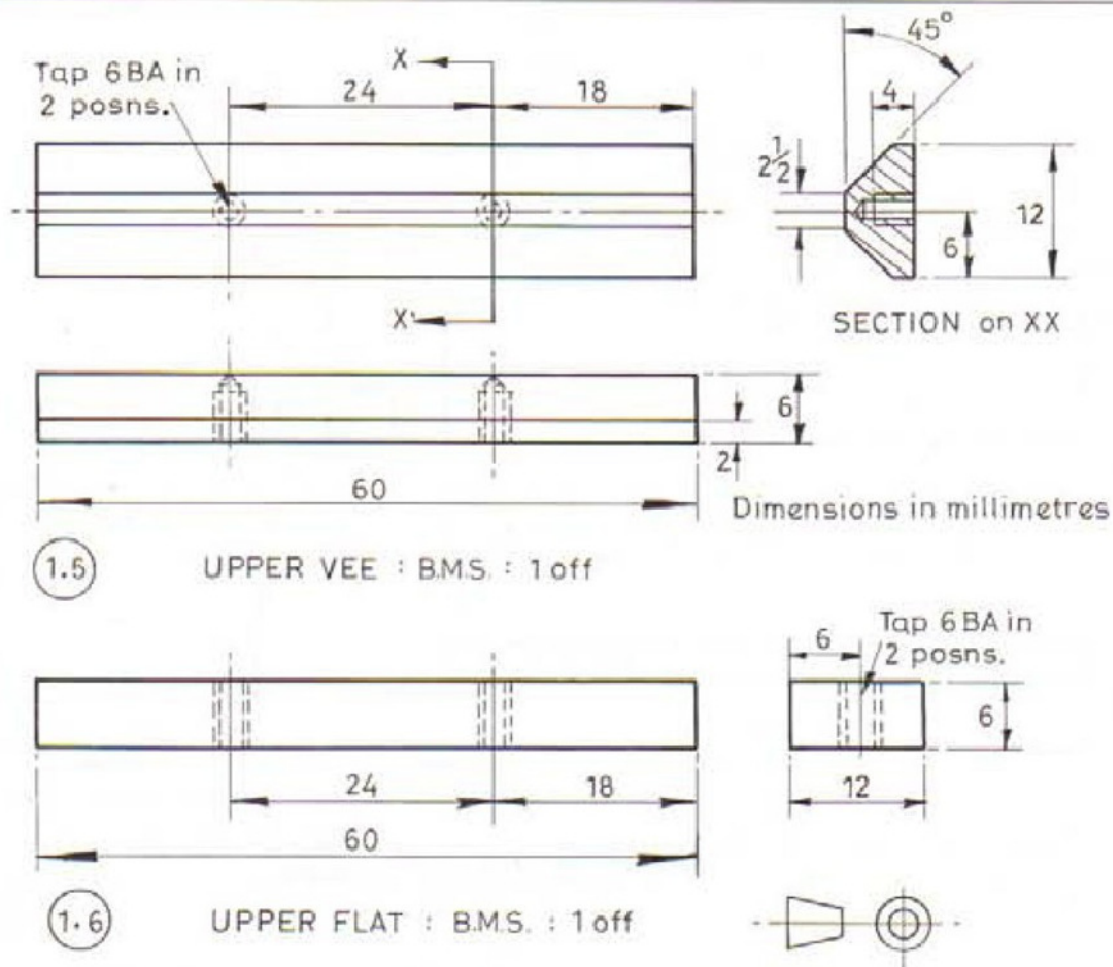
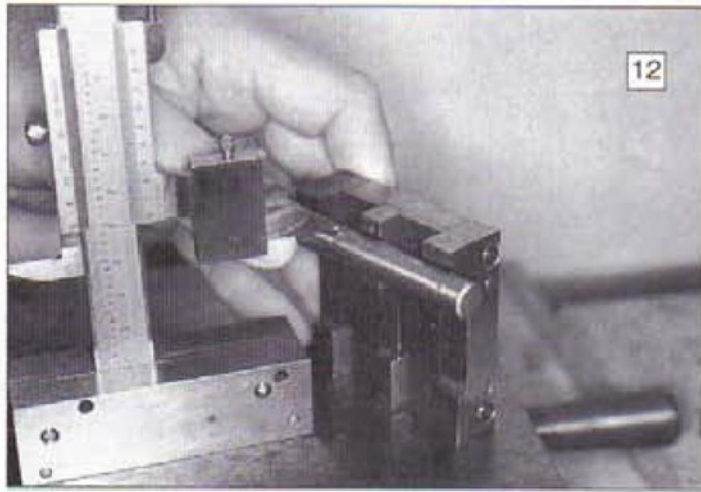
### A small difficulty

Due to the way the Unimat's motor is fixed to the motor plate and the whole assembly fits to the lathe, there is no way, however carefully made, that large diameters can be held close to the chuck or spindle with a raising block without fouling the motor. The only way to get round this problem without too much trouble is to have the work sticking out from the headstock about 60mm. This, in turn will mean that all the large work would have to be done on a mandrel, needing the same raising block under the tailstock.

My solution was to move the whole motor assembly back, by extending the lathe spindle and standing the motor plate off on pillars. Both the spindle extension and the pillars are shown in **fig.3**. They are a simple turning job as long as some of the dimensions are accurate. These are, the 10mm diameter on the spindle extension which fits up the lathe spindle and the 12.9mm and 14mm ones which the driving pulley fits on. It went well when I machined it, until there was a bang and everything went slack. The small driving belt had broken and it was a weekend. I had to suspend operations till I could get to the shops. I've moaned about the Unimat belts before and I used the same substitute as I did for the large belt, a vacuum cleaner belt. They are made from thicker material than the pathetic 'O' rings which Unimat use, 7mm instead of the bit under 6mm of the 'O' rings. They work just as well because they bear on the flanks of the pulley and don't bottom in the groove. They do, however, leave a black deposit on the pulleys and surrounding metalwork and tend to be a bit







sticky. I correct this by coating the new belt with talcum powder; French chalk would do instead. This time I was caught without either so my wife gave me some old face powder; the lathe smells lovely now!

The two pillars, (Item 3.2) replace the bolts which fasten the motor plate to the headstock, the bolts being used to fasten the motor plate to the pillars. The assembly of the new position is shown in **photo 17**.

Another small item needed is the locking pin shown in **fig.4**. It locks the extension spindle by screwing into the tommy bar hole in the lathe spindle just to the right of the pulley. 2BA will tap through this hole easily. A thin nut can be used for locking if necessary, but I've

found that the very slight errors from cross-drilling the spindle, machining errors etc. will usually make a tight enough fit.

Finally, **fig. 5** shows the last component to be made, an extension for the toolpost. Once again, stock material and a simple drilling job.

To assemble the completed raising block, the original cap head screws are removed from under the headstock and replaced with longer ones, 50mm long. It is a good idea to take the motor plate off while fitting the raising block. Things get a bit awkward with the various parts all trying to go their own way. I write from experience.

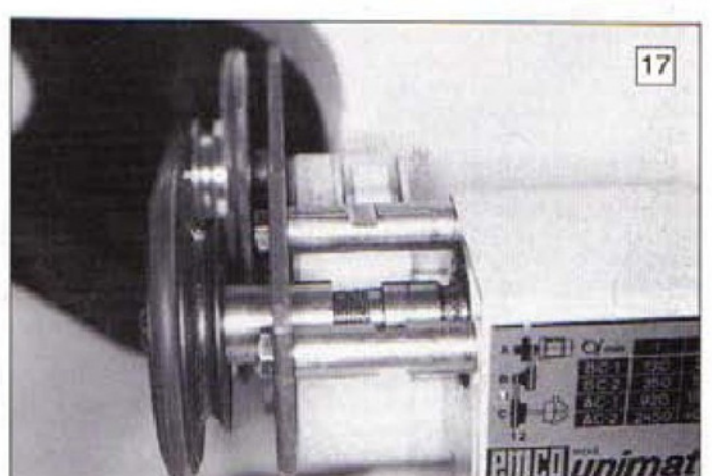
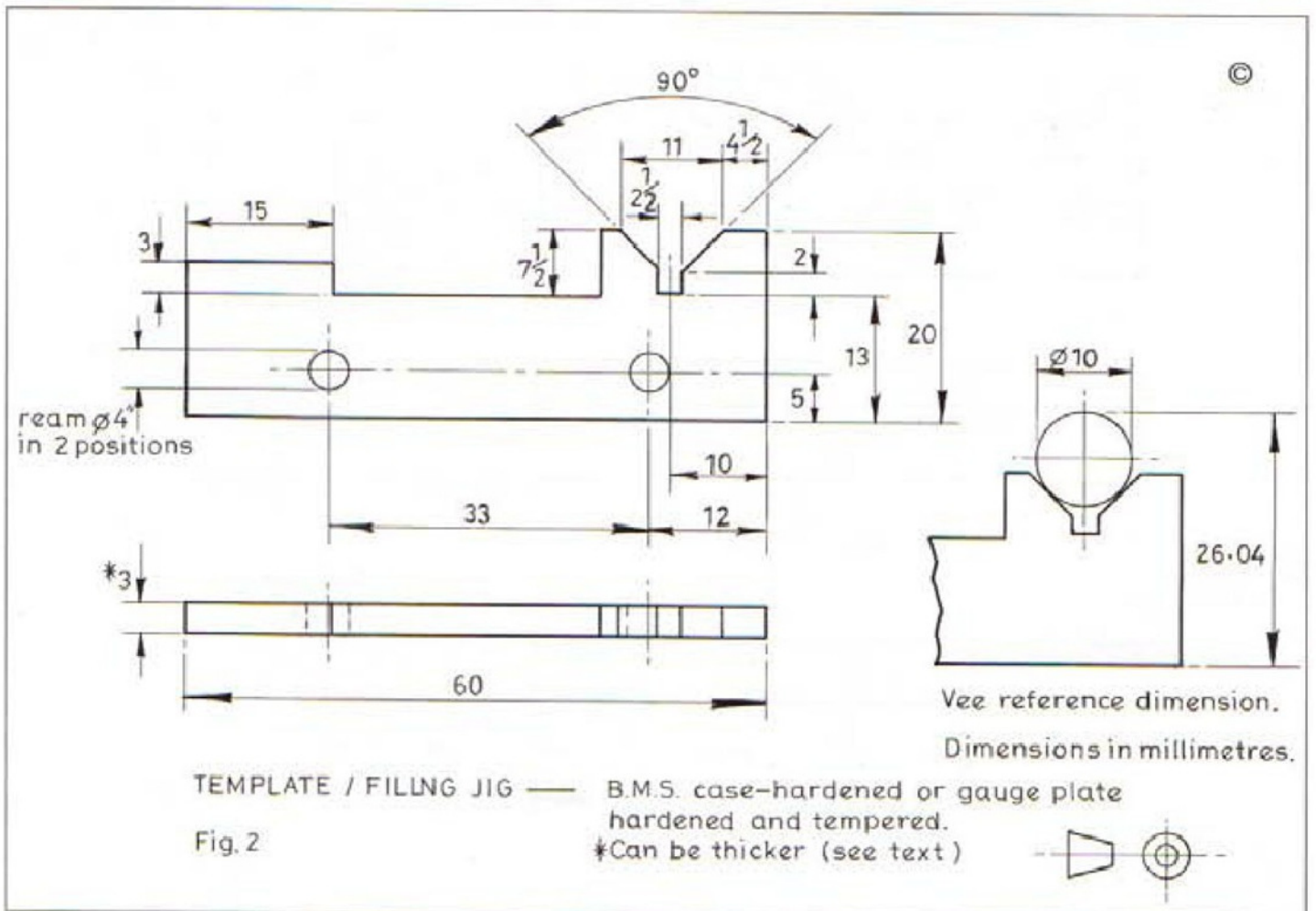
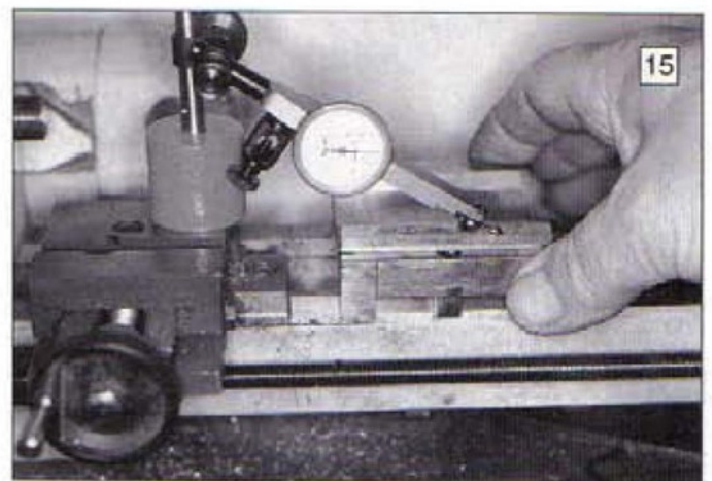
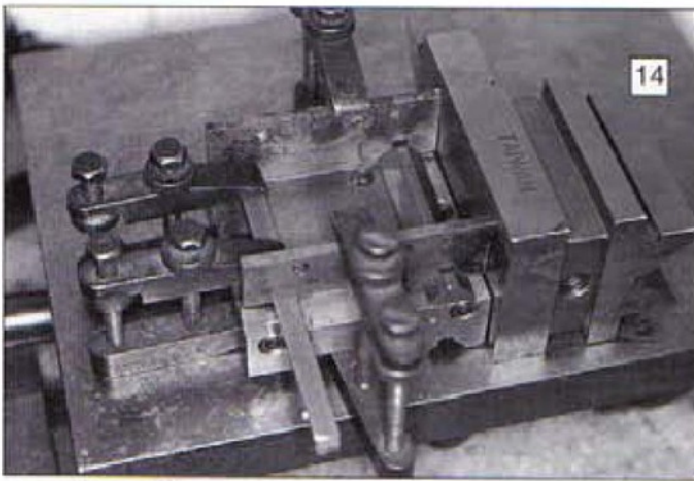
That concludes the making. The photo. at the head of this article shows a job

which would be the sort of thing I had in mind for it. There is no way I'd actually attempt to machine it using this set-up, I'd have a support of some sort as well as the mandrel it is mounted on, preferably in the tailstock. So the business starts again. I have the block in **photo 1**. It only needs an upper Vee and flat. I'd better get busy.

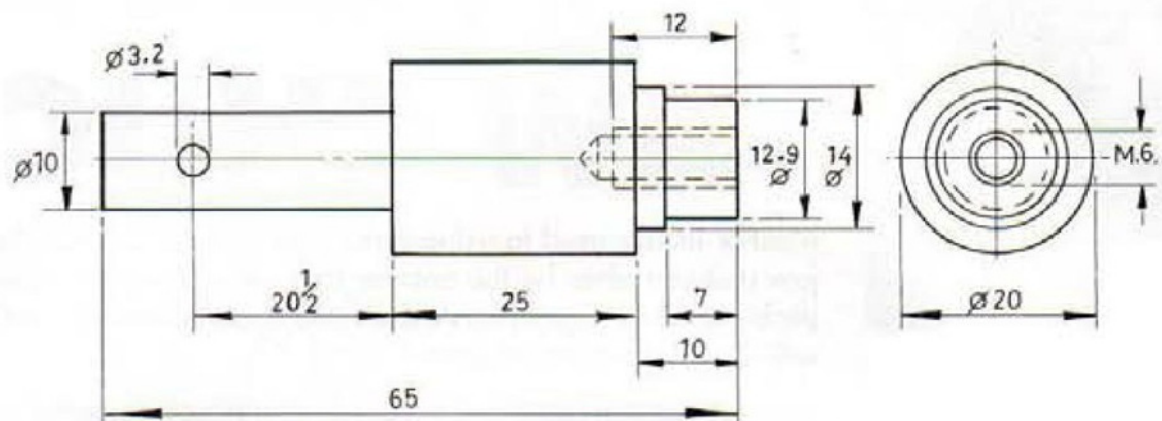
\*Kasenit is no longer manufactured, so unless one can hold of some old stock this will be an impossible product to obtain. An equivalent case hardening compound is available from Speedwell Tool Co., 62 - 68 Meadow St, Preston, PR1 1SU. Tel. 01772 252951. Prices are £8.50 per 500g. tin, or £4.50 per 250g. tin, plus VAT and p&p. - Ed.



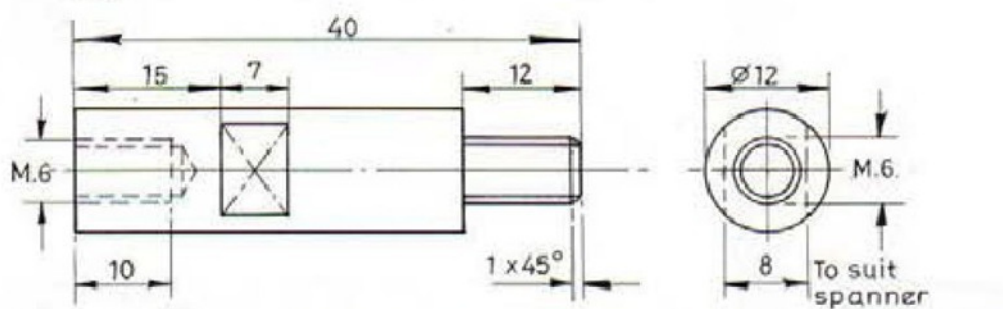








(3.1) SPINDLE EXTENSION : B.M.S. : 1 off



(3.2) PILLAR : B.M.S. : 2 off

Fig. 3

Dimension in millimetres

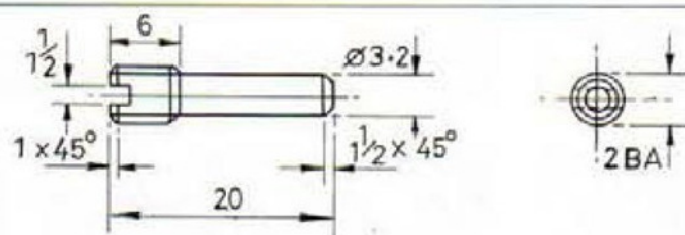


Fig. 4 LOCKING PIN : B.M.S. : 1 off

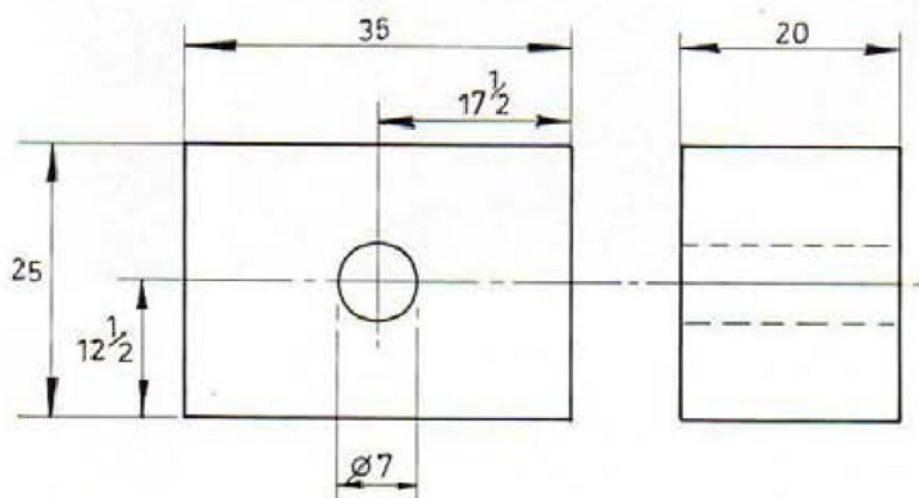
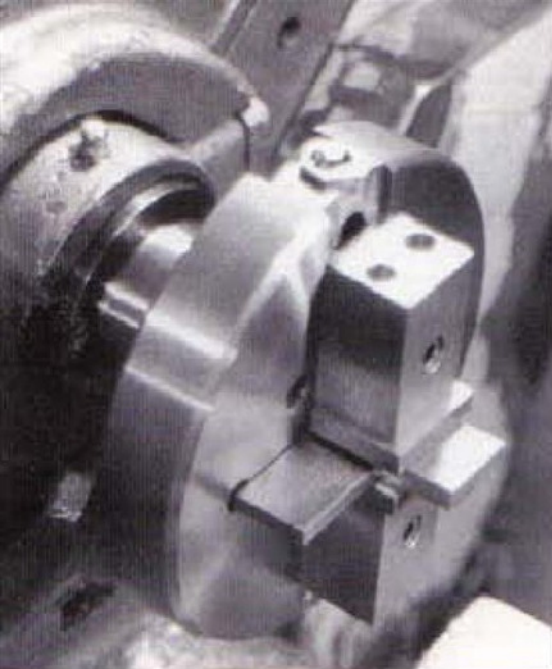


Fig. 5 TOOL POST EXTENSION : B.M.S. : 1 off

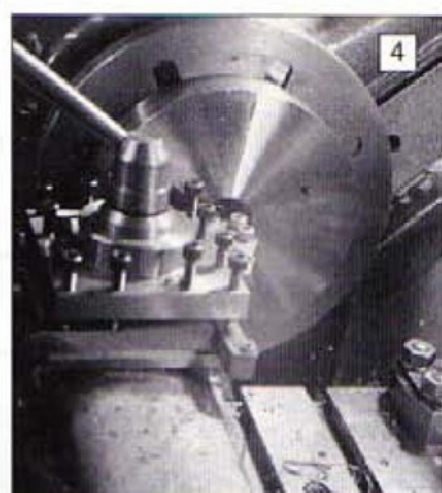
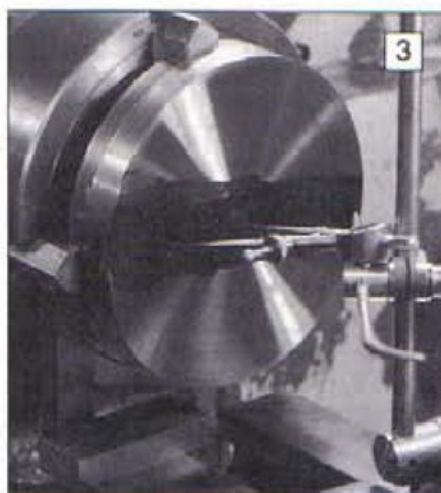
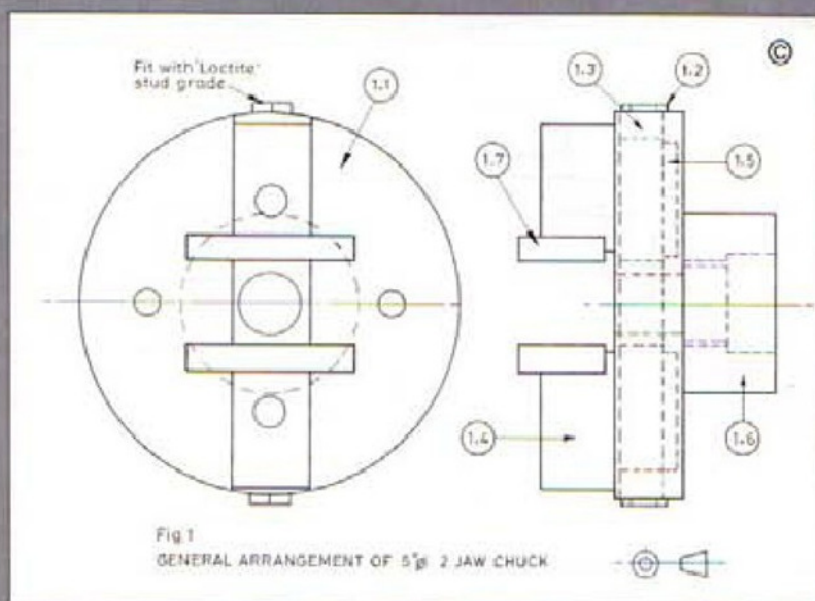
Dimensions in millimetres





# A TWO JAW CHUCK

Most of us are used to using three and four jaw chucks, but a two jaw unit can often be the answer to a difficult work holding problem. Mark Figs has devised this 5 inch diameter unit which will accept a variety of jaws.



This chuck was conceived after seeing large models in an industrial machinery catalogue, and seeing them used in a machine shop making malleable iron pipe fittings, on large auto's and turret lathes. While making steam fittings for my American 4-8-4 loco, the thought came, "One of those would be handy to fit the Myford", and after a bit of scheming I came up with this design.

The chuck is made of steel, with removable jaw plates, made out of soft

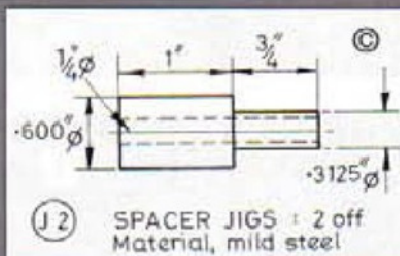
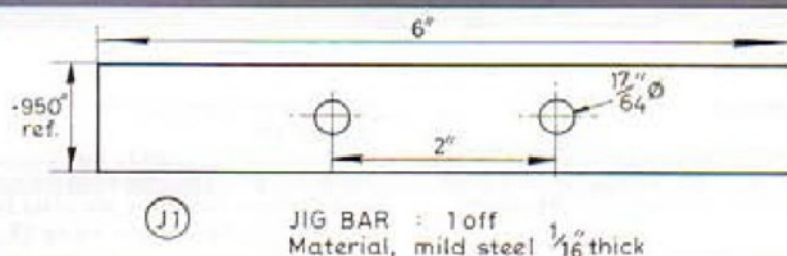
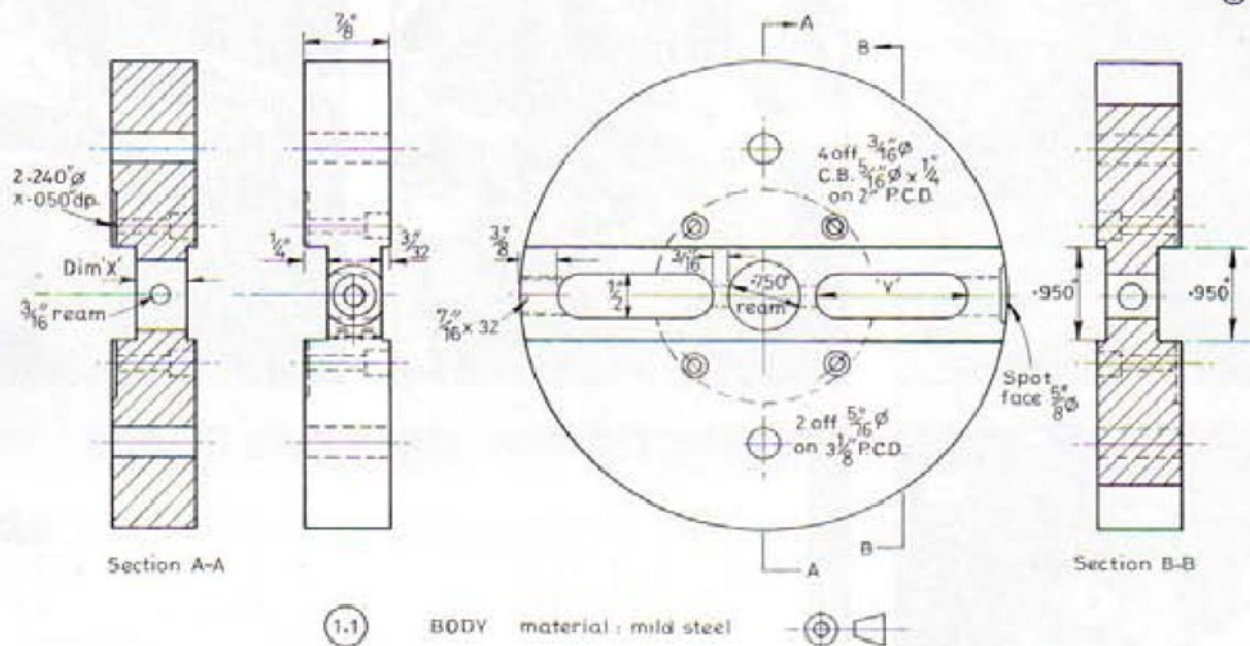
materials e.g. nylon, brass etc., which can be shaped to suit special jobs. There are two holes at 90deg. to the jaws for fitting work stops or fixtures for multi part jobs. It can be used like a machine vice on a faceplate, but with a lot less mucking about.

The jaw operating screws are  $\frac{5}{16}$ in. BSW. I used left hand simply because I had the taps and the screws move the jaws the "right way", but there is no reason not to use ordinary right hand. I have

shown a mounting boss to fit the 'Myford' mandrel nose; this is optional. Alternatively, use the catch plate with a register, not that much work is done between centres and the catchplate gets little use.

This chuck was made using a  $\frac{3}{16}$ in. lathe and a milling machine. However, all the operations have been checked out using a 'Myford' and a vertical slide. It is for this reason that the  $\frac{3}{16}$ in. PCD holes are included.





Parallelism is vital on this job, not only in the thickness of the body but also the jaw register grooves.

### Does your faceplate run true?

If not, set it up on the mandrel, taking care to make sure the threads and register are clean, and skim it. Experience has shown they 'creep out' with age and use. When re-mounting the faceplate on this job *always* check it for truth.

### Preliminaries

I find it best to prepare any jigs and aids before starting, it saves a lot of setting up and taking down. The jigs are very simple, but without them setting up would be a headache.

Prepare jig bar (J1). I used a sacrificial bar of Dural to bolt the jig to, and mill to 0.950in. width, both sides at the same setting. (Photo 1).

Keeping the jaws in one piece, mill one face to finish, at the same setting, mill to width of 0.950in. for a depth of 3/16in. (Photo 2).

Face 1 off 2in. length of 0.5in. dia. ground steel rod for a setting pin.

Face 2 off 2in. lengths of 0.3125in. dia. ground steel rod for setting pins.

For lathe only builders, prepare 2 off spacer jigs (J2) to replace the above pins.

### Item 1.1 Body

Set in the 4 jaw and face to a clean finish. With your smallest centre drill, mark a very small centre, just enough to take the divider point. Scribe a line across the dia. at centre height and mark the 2 off holes at 3 1/8in. PCD (Photo 3).

Drill, bore & ream the centre hole to 0.5in. dia., then bore a recess 0.080in. deep x 0.950in. dia. This serves as a datum when milling the jaw slots. Drill the 2 off holes on the 3 1/8in. PCD, 1/4in. BSF tapping and tap. Carefully de-burr.

Mount on a true running faceplate (machined face to the plate) using studs and nuts, with the 0.5in. precision ground pin in the centre hole, clocked true. Face off to thickness.

Bore and ream 3/4in. dia. (this diameter is not critical, but can be very

useful when setting up some jobs, by providing a datum) then bore a datum hole 0.950in. dia. x 0.225in. deep, followed by a 2.240in. dia. x 0.050in. recess. Skim the OD true to diameter. (Photo 4).

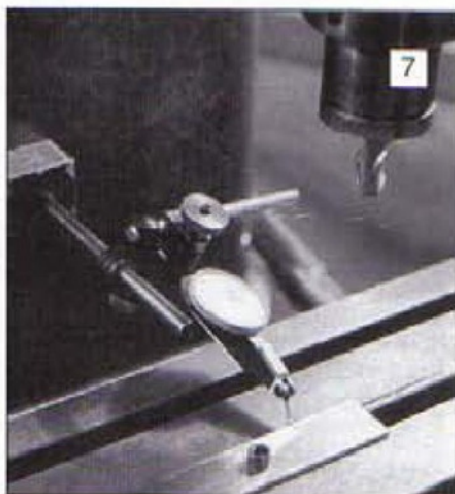
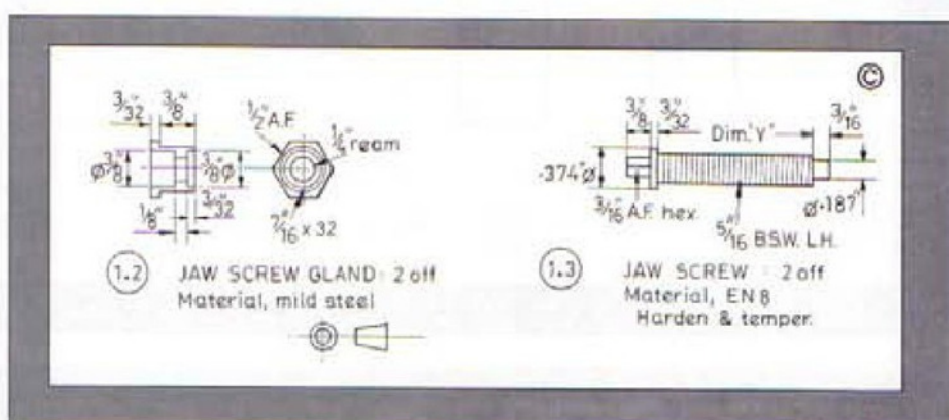
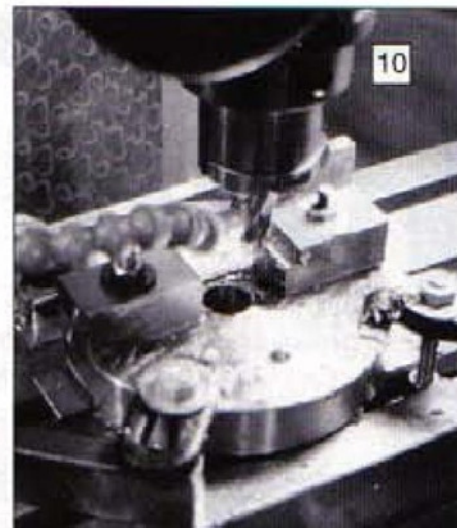
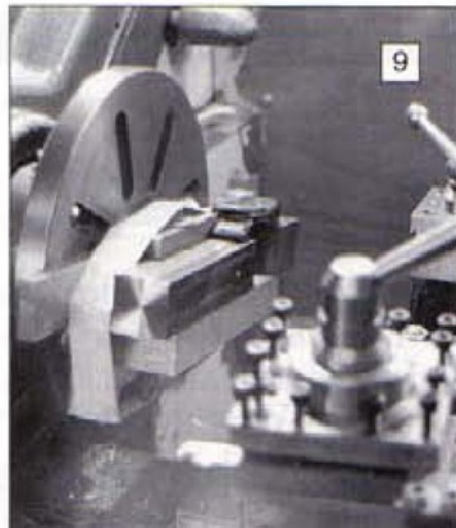
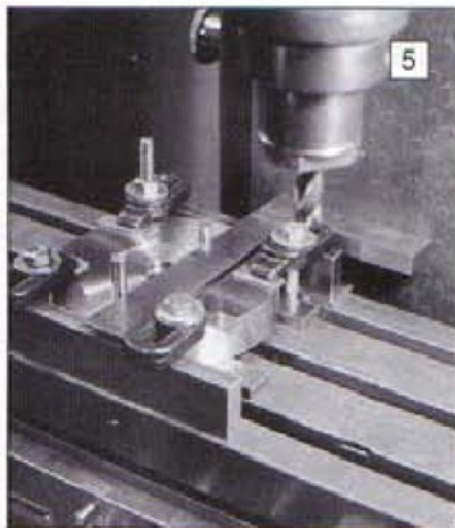
Drill out and ream the 2 off 1/4in. BSF holes to 0.3125in. dia. before clamping to the mill table on known parallels, back face up, using 0.3125in. setting pins at 90deg to the table axis. (Photo 5).

### Lathe method

Fit up the vertical slide, clocking it true at 90deg to the lathe axis. After fitting the two setting jigs (J2) in the 1/4in. reamed holes, (using 1/4in. studs & nuts), fit the body to the vertical slide. Using a square off the bed against the jigs J2, tighten up firmly and proceed as follows. (Photo 5 shows the principle; just imagine the mill table is the vertical slide and the column the lathe bed).

Mill the 1/4in. deep slot 0.950in. wide to datum, using the jaw as a gauge to a tight push fit. Change to a 1/2in. slot drill and mill the two through slots (Photo 6).





### Mill method

Bolt the jig bar (J1) to the machine table with 2 off 1/4in. BSF cap screws, and clock the bar true to the table axis (Photo 7).

### Lathe method

Bolt the jig bar (J1) to the vertical slide centre slot, in a horizontal plane and clock true. Bolt the body to the slide through the 2 off 5/16in. holes, then proceed as follows:-

Clamp the body down over the jig bar J1 and mill the slot, using the 0.950in. dia recess as a datum, to a tight push fit on the jaw (Item 1.4), thus ensuring that the two slots are true to each other across the diameter (Photo 8).

### Jaws (Item 1.4).

Mark out the centres of the 3/16in. dia. reamed holes and set up the jaws on an angle plate attached to the faceplate, with a parallel behind. Centre one of the marks and clamp. Drill, bore and ream the 1/4in. through hole and the 3/16in. counterbore. When first hole is completed, move the jaw along the angleplate and re-clamp (without turning it over). Repeat the drilling operation. (The tape in Photo 9 is to stop any packing flying out).

Cut the jaw material in two and face to length. Fit the jaws to the body, in the 3/32in. deep slot with temporary bolts. Clamp the body down over the undisturbed jig J1 and mill the jaw steps. This ensures that the faces of the jaws are

square to the body in all planes (Photo 10).

Finish mill the jaws to the drawing dimensions and counterbore the reverse side. De-burr. Leave the jaw plate fixing holes till you have made the jig J3.

### Fitting jaws to Body

Carefully de-burr all over, using a fine Swiss file. Working on one sliding face only, fit the jaws to the body to a stiff slide fit. Using an anti-seize assembly compound to lubricate the slides as you go (I use *Coppereaze* made by Comma Lubricants), as the copper in the compound prevents any 'galling'. Your local motor parts shop can supply, and it has a myriad of uses.

### Finishing the Body

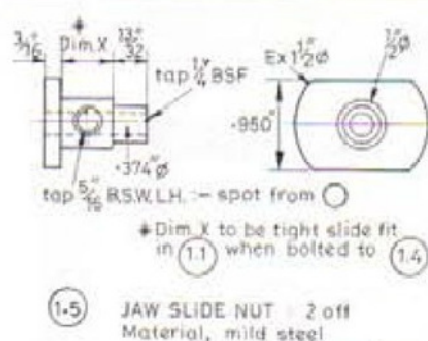
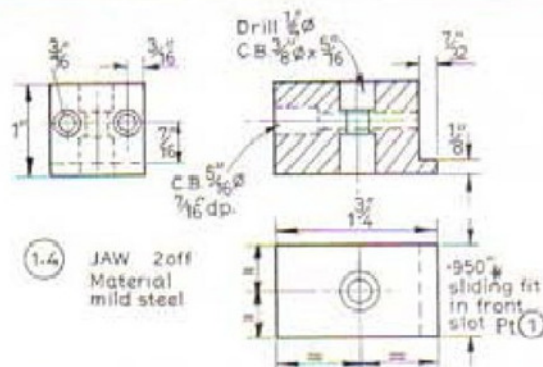
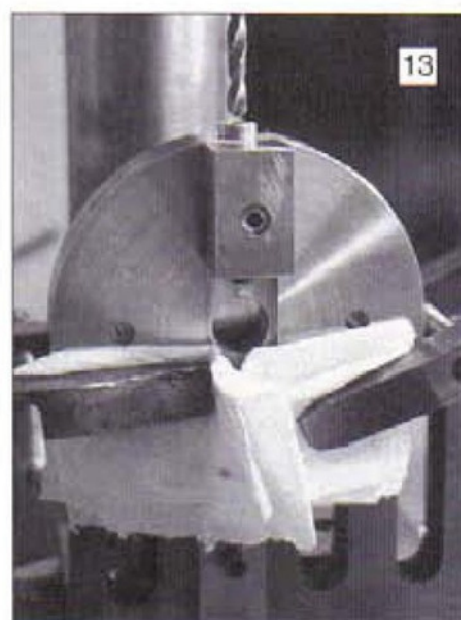
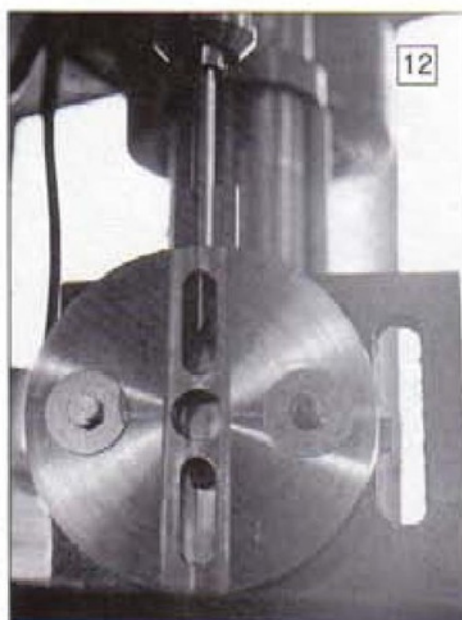
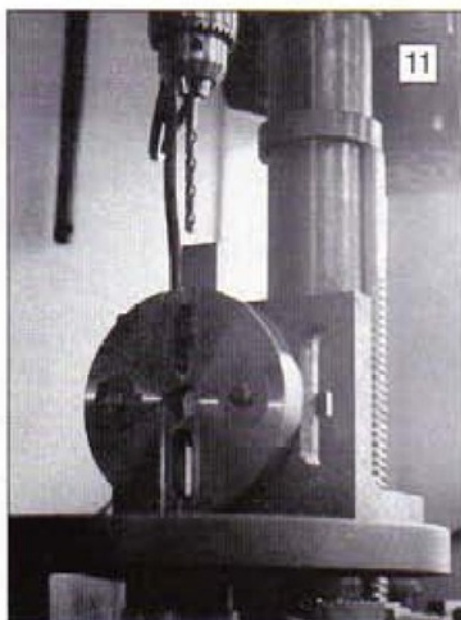
Fit jig J1 to an angle plate, in a true vertical plane. Mark out the centre of the jaw screws and bolt the body over J1. Centre under the drill and bolt to the drilling machine table. Centre drill, open out to 5/16in. dia. and spot face 5/16in. diameter.

With an extended centre drill, (3/16in. centre drill 'Loctited' in) to a bit of 5/16in. silver steel) drill and ream the 7/16in. dia. inner hole. Open out the outer hole to 7/16in. x 32TPI tapping, then tap, using the drill press to keep the tap true (Photos 11 & 12).

Rotate on the jig and repeat, without disturbing the jig/angle plate. It is best if







this set-up is left undisturbed, as you'll need it for Item 1.5.

## Jaw Screw Glands (Item 1.2)

These are screwcut in the lathe to ensure truth. It's best to make a gauge in an odd bit of stock, using the same tap that you used for the body, and screwcut to this.

When reversed to machine the 3/16 in. counterbore, fix the gland in a screwed bush to ensure concentricity. While you are set up to screwcut, make a drilling guide bush with a bore of 5/16 in. BSW tapping size out of a bit of 1/2 in. rod.

## Jaw Slide Nuts (Item 1.5)

I cut these 3/4 in. over length, to allow a chucking piece for machining.

Turn a chucking piece about 3/4 in. dia, reverse and turn to size, leaving dimension X overlength, with an undercut at the 0.374 in. dia. to 1/2 in. dia. shoulder. Drill and tap 1/4 in. BSW.

Mill the flats 5-10 thou undersize. Fit to the body with the jaw, tighten up and measure the gap with a feeler gauge. Re-mount by the chucking piece and face off the shoulder by the feeler reading. Go easy! we want a tight, shake free sliding fit, otherwise the jaws will lift when tightened. If you get it in one, well done; there's no shame in another try.

*DON'T* remove the chucking piece until final assembly is completed and you are satisfied with the fit and action of the jaws.

With the jig J1 still set on the angle plate, assemble one jaw on to the body, clamp to the jig, screw in the drill bush and drill Item 1.5. Tap the 5/16 in. BSW thread, using the drill press to keep the tap true (Photo 13).

## Jaw Screw (Item 1.3)

I made these from EN8M steel, which can be a bit harder to machine, but with sharp tooling and a neat cutting oil, a good result is quite possible. Screwcut the thread, but reduce the O/D of the thread by 0.010 in. dia. to ensure that the thread bears on the flanks not the crests. Use the jaw slide nut as a gauge, leave dimension 'Y' overlength, to allow for final fitting.

Mill the hexagon flats using a 3/16 in. end mill, leaving a radiused run out to avoid a stress point, using whatever dividing facilities you have (Photo. 14).

If you have no dividing head, make a threaded bush out of hex bar and use this to index each flat by gripping it in a machine vice.

## Hardening and tempering

When you are satisfied with the fit on assembly, heat treat as follows:- Suspend the screw vertically on a bit of

# QUICK TIP

## Preventing scale

To prevent scaling during the hardening of a part that is difficult to clean up, heat gently until it just starts to discolour, then dip the part in common borax powder. If necessary, re-heat and dip again to provide a good coating. Bring to the necessary re heat and quench, when the borax will flake away leaving a matt grey finish.

G Hugh Dawkins

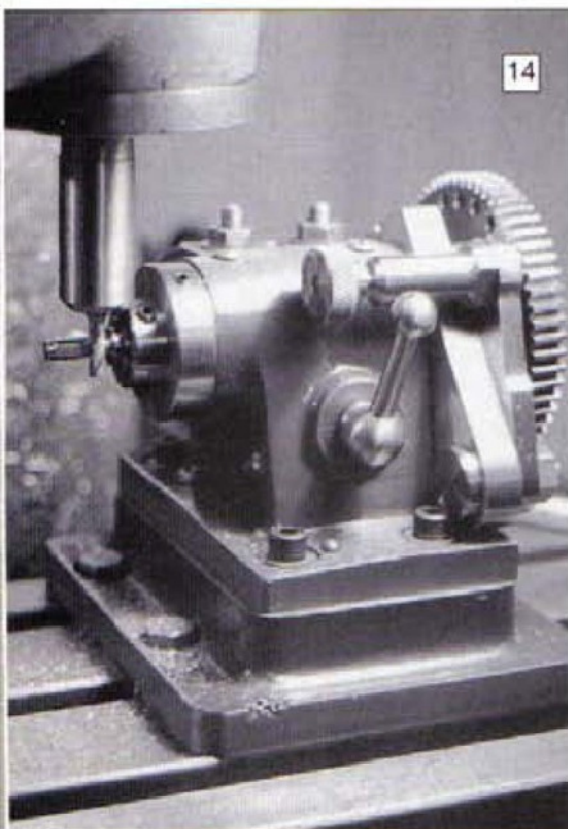
wire, heat to bright red and quench vertically in oil.

Clean up and again on wire, gently heat to a light blue and quench as before. This has worked well in service for me, using the minimum of equipment.

## Final assembly

On final assembly, grease the threads and jaw slides with *Coppereaze*.





14

### Optional Mounting Boss (Item 1.6)

The best recommendation I can make for this part, is to refer to *Model Engineer*, Vol 167, No 3909 :- Tubal Cain's, *Master & Slave Chuck*, which goes into great detail on how to machine mandrel threads and registers.

### Mounting the 2 jaw on the catchplate

Set up your catchplate, taking the usual care to clean the mounting threads. Skim the face and OD true, turn a register spigot 2.240in. dia x 0.055in. long, with a definite undercut in to the face, so that the chuck body seats on the spigot where the bolts go through, *not* on the rest of the backplate. When aligning the body on the catchplate, arrange the  $\frac{5}{16}$ in. holes to clear the drive pin boss on the casting.

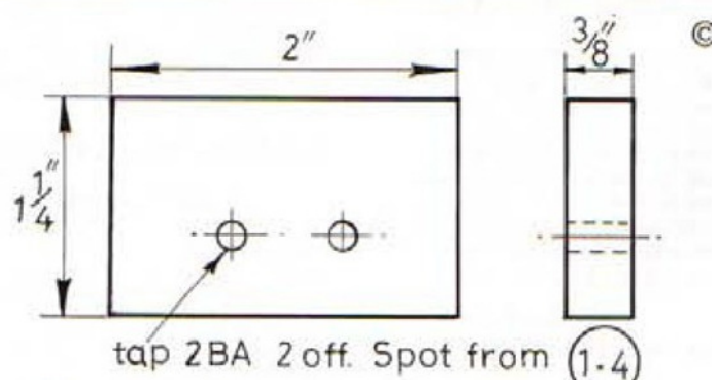
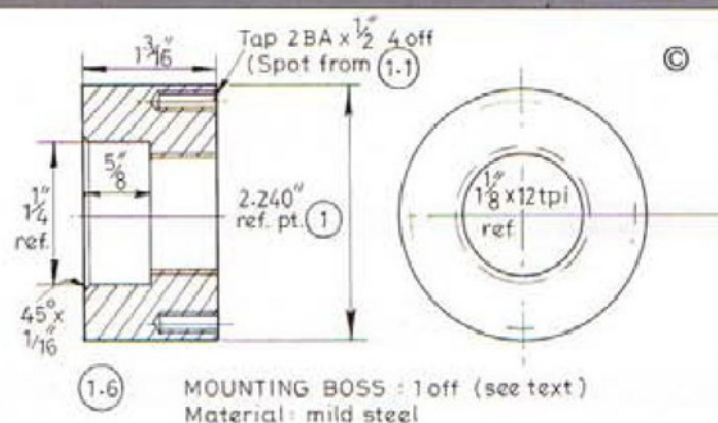
Drill the  $\frac{3}{16}$ in. holes and counterbore on the 2in. PCD in the body, noting that the



15



16



## QUICK TIP

### Painting castings.

To prevent paint adhering to the machined faces of cast items, especially when spray painting, mask these areas by drawing over them with a wax crayon. When the paint is thoroughly dry, simply pour a kettle of hot water over the item and wipe the masked surfaces clean.

C. Washington







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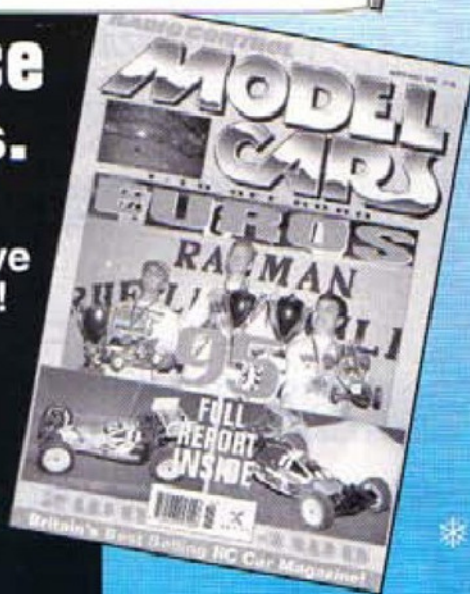


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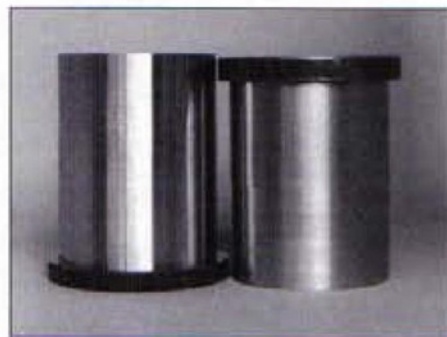
## Sumitomo Insert Lathe Tools

These well known lathe tool inserts are now marketed by Penco of Sheffield. Proprietor Nigel Kelly sends us details of a test which may be of interest to readers in that it demonstrates the difference in surface finish which can be obtained from their titanium carbide insert, compared with that from a tungsten carbide version. Two pieces of material, thick walled steel tube of about 2 1/4in. diameter were turned at the same speed and feed, using inserts of the same tip radius. The photograph shows the improvement obtained from the titanium carbide insert.

The range includes inserts with tip radii down to 0.1mm, thus encompassing all work from roughing to finishing.

Turning and boring toolholders are available, the turning tools having shanks from 6mm to 16mm square, while the smallest boring bar can deal with a hole of only 6mm bore.

*Penco, 3 Greenfield Close, Sheffield S8 7RP. Tel. or Fax. 0114 237 7716*



## Tool Catalogue from Germany

Precision hand and machine tools are listed in the 100+ page catalogue published by Messrs. Fohrmann Werkzeuge GmbH of Waltrop, Germany. The catalogue, which contains details of each listed item in German, English and French, also features materials and components such as bearings and gears.

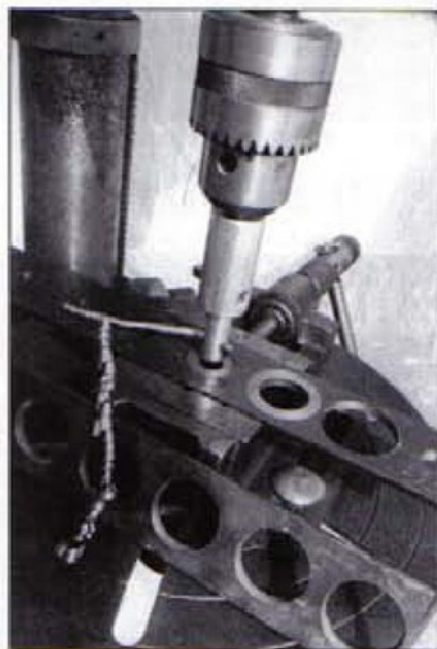
A particularly interesting feature is the list of specialised tooling for dealing with the smaller gauge model railway items. These include a roll-over stand, a wheel-pressing jig and a running-in stand for HO gauge locomotives.

The catalogue is supplied on receipt of 6 international reply coupons. For personal callers, the retail shop, at 7 c-d Sydowstrasse, is open from 1100 to 1300 and from 1500 to 1830. Waltrop lies to the North of Dortmund, close to the A2 from Cologne to Hanover.

*Fohrmann-Werkzeuge GmbH, Post-box 146, D-45722 Waltrop, Germany. Tel. 0 23 09 29 62 Fax. 0 23 09 7 35 38*

## An Australian boring tool

The Practool Super Drill, developed principally for sale to farmers, is now available through a U.K. agent. Designed for use in standard pillar drills, this is essentially a single point boring tool mounted on an arbor which is equipped with a pilot pin. Two cutters are mounted on the arbor, each being adjustable within limits.



The three tools which make up the range cover 1/8in. to 1 1/2in. (Standard Super Drill), 1/2in. to 2in. (Farm Pack) and 1in. to 3in. (Boxed Industrial Set). The last of these comes with a No.3 Morse taper shank only.

The agents claim that, because of the boring action of the tool, it will cut cleanly through mild steel, cast iron and aluminium, without snatch as it penetrates. The cutters are of high cobalt steel and have flat cutting surfaces which are easily re-sharpened on an oil stone.

*Practool Super Drill, Castell Draenog, Llanboidy, Whitland, Dyfed. Tel or Fax. 01994 448 315*

## A wood cleaning solution

Many mechanisms which present themselves for restoration live in wooden cases which themselves are in need of tender loving care. We were able recently to observe a demonstration of a wood cleaner which appeared to be very effective on a number of types of timber. Based on the familiar oxalic acid formula, the compound appeared to be much more effective than the solution obtained by dissolving the simple acid crystals. It is capable of dealing with awkward joints, rebates, mouldings and veneers and makes possible an acceptable match between new and old wood.

*Barden & Stevens Ltd., 3 Jonas Nichols Square, St. Mary's, Southampton SO14 1JD. Tel. 01703 394993*

## New engineering epoxy resins

Wixroyd International have launched a new range of filled epoxy resins which are designed for the long-lasting repair of materials such as aluminium, steel, concrete and glass. They can also be used to make moulds, models, jigs and patterns as they have a notably low shrinkage rate. Available as putties and pourable liquids, they can be handable after 16 hours, with final hardness achieved after 24 hours. High temperature variants can be obtained, as can self-lubricating plastic metals.

Also in the range is a ceramic plastic liquid metal, which is a mineral (corundum) filled material, which can be brushed to provide a smooth surface with high chemical resistance. It may be used to protect, repair and recondition components, the protective layer resisting wear and abrasion.

*Wixroyd International Ltd, Alexia House, 145 Brighton Road, Redhill, Surrey RH1 6PS. Tel. 01737 768823 Fax. 01737 767323*

## Heavy Duty Angle Grinder

From Clarke Power Products comes this new heavy duty 9in. angle grinder. Weighing less than 8.5kg., it has a 1700 watt motor, which produces a no load speed of 6600 rpm. This grinder features double insulation and a safety on/off switch and a fitted plug.

*Clarke International Tel. 0181 986 8231*





# SCRIBE A LINE

Your views, your pages! Your opportunity to make a point, ask questions or simply pass on a snippet of interesting advice or information to others. Your letters for publication M.E.W. are always welcome.

## Readers get together

From Charles. W. Plummer, Kalamunda, Western Australia

I intended making a ball turning tool, so in the Nov-Dec issue of M.E.W. (No. 26), the one by Phil Thomas, of Booragoon, Western Australia, was read with interest and I decided to look up his phone number and give him a ring. This was done, and Booragoon being only half an hours drive from Kalamunda, led to us spending several very pleasant hours together.

He was very pleased to tell me that he had received half a dozen phone calls regarding his ball turning tool, one as far away as Albany, on the South coast, and that's 250 miles away.

I think giving the author's name, area, State, especially in Australia, an excellent idea, as this will promote the getting together readers of M.E.W., with mutual benefit to all.

## Biography of F.J.Camm

From Les Rix, Melton Mowbray, Leicestershire

October 1995 saw the centenary of Frederick James Camm, practical engineer and editor of many popular magazines, affectionately referred to as 'Camm's Comics'; a small exhibition is projected in Windsor at the end of the year. For some time, a biography of FJ and illustration of his work has been underway.

His interests and proficiency spanned pioneer aviation, model-engineering and wireless, leading to the publication of 120+ books and the manufacture of motor-cars and personal aircraft. He was sometime FRAeS and FRSA, and the holder of a number of patents.

Some of his works remain a mystery and his personal life is a cipher remarked mainly by tragedy and unfortunate legal action. He was a 'workaholic' and collapsed at his office desk one Sunday in 1959, abruptly ending a life in the best traditions of the self-taught Victorian engineer and technical mentor.

The writers are still seeking published or personal written information and anecdotal reminiscence to complete this study of Fred Camm and any comments or identification of material would be most gratefully received.

Contact Nos. are:- Tel. 01664 480411 Fax. 01664 60951

## Workshop security

From Gordon B. Watt, Swindon, Wilts

In the Sept./Oct. issue you published an excellent article on security. As a Senior R&D Engineer, specialising in security, for a large public corporation, with twenty years

experience in security, I would like to add the following comments.

I am pleased to see that your advisor recommends making the fabric of the building secure. Too many people rely on alarms. An alarm only goes off when someone is inside the premises and even if he runs away, he still has the opportunity to grab something of value as he goes. However, if you have a scale model of King George VI in your shed and someone wants it, there is very little that you can do to stop them. Anyone prepared to steal a model weighing several hundredweight is a professional and they will find a way to get it. You can of course make it difficult for him (or her).

Double skin walls and roof are essential if the shed is made of wood. Plywood is actually one of the most difficult materials to break through. We use it in a sandwich with expanded metal and various other materials for strengthening temporary structures. Brick built workshops are good, but do not forget the roof. Tiles come off very easily. Your door should be solid. In addition to hinge bolts, as mentioned in your article, it is worth fitting two locks, about a third and two thirds of the way up the door. A door with a single mortise lock can be opened in about ten seconds. A good idea is to screw a length of angle iron to the edge of the door so that the angle overlaps the jamb when the door is shut. This makes it extremely difficult to jemmmy.

Casual attackers are often easy to scare off. They do not like having attention drawn to themselves. Security lighting that switches on when they approach can help. Fitting an alarm will also help. If the alarm makes a lot of noise the attacker will not stay around for long, because he will not be able to hear if someone is coming. Sounders that produce about 120dB are fairly cheap. Fit at least two or more inside the shed. The sound impact will disorientate the attacker and he will leave.

One thing to watch about alarms is the regulations on noise pollution. Alarm bells should stop automatically after twenty minutes. Longer than this and neighbours can complain to the council. If they do, the council now has the right to break in to your premises to silence the alarm. They will do an excellent job of repairing any damage that they cause, but you will get the bill for the work.

Your local Crime Prevention Officer is the best person to contact for immediate advice on what measures you need to take in your area. He will know what type of activity takes place in the locality and will have knowledge of what measures have been taken by others. He will also have information from local crimes, where the local criminals have succeeded in defeating various measures.

Here at the R&D centre we test to destruction many of the devices and

systems that security companies make. This way we get to know their weaknesses. This in turn helps us to match equipment to a problem. No two situations are the same. Each one needs individual consideration.

## More on interference

From K.A.Wilson, Fleet, Hampshire,

At the risk of prolonging this discussion, it appears that David Wilkinson has made good progress with his problem but still needs a final solution.

1) It is not surprising that the use of ferrite beads only provided some improvement, since their effect is usually more efficient at higher frequencies than appear in this case.

2) The enclosure of all the wiring connected to the filter within a soundly constructed screening (and safety) box will help in keeping the interference down, making sure it is reliably earthed to the enclosure, as well as bonding the screening of the cables to the box at the point of entry. The box should be but a larger part of an all enclosing screen.

3) Taking off the earth!! Apart from the stated potentially lethal side effects, as well as ignoring the IEE Regulations, here we have a further clue to the problem. If removing the earth conductor has the effect of reducing the interference, it must be acting either as an aerial or as a conductor of the interference. One explanation may be that its impedance to earth at radio frequencies, as opposed to the 50Hz mains frequency, is too high and a local earthing arrangement would improve matters.

Use of a properly installed earthing rod, as close as possible to the equipment, may provide the final solution. Such rods are available from electrical wholesalers and are required use for site temporary installations. The earth conductor part of the electrical supply cable should remain in use, but a heavyweight copper direct connection to the earthing rod should be made in addition. This should ensure that the source of the interference is properly grounded.

## Extending the technology

From G.W.Procter, Ripon, North Yorkshire

Regarding your remarks in On the Editor's Bench, Issue No 30, saying that most of our home workshops are stuck in a time warp.

I would hope that your editorial efforts will be directed towards encouraging readers to extend the scope of their activities. When I retired in 1981, I made a conscious decision to extend the scope of my hobby workshop, by taking advantage of the many second-hand machines now



available cheaply. These include: Surface grinding, J & S 540; cylinder grinding, J & S 1212 and Churchill; tool and cutter grinding, J & S 310 and Clarkson; gear hobbing and gear shaping machines, slotting machine, punch shaper plus the usual run of shaping machine, milling machines and lathes, mostly bought cheaply and rebuilt by me to a satisfactory standard for accurate work. None are CNC!

I mention this to indicate the much higher level of satisfaction to be achieved by, for example, making Morse taper shanks on a grinding machine, compared to the struggles mentioned in some of your articles on turning tapers.

If I buy a machine with change gears missing, I simply set up a gear cutting machine and make a set. I even make my own gear cutting hobs if necessary. This involves Workshop Technology on a higher plane than your average reader uses perhaps, but, this is my point. There is a huge gap between this and CNC machining which offers great scope for your efforts with Model Engineers' Workshop.

I have been involved in model engineering workshops for the past fifty years and have seen dramatic changes, mostly for the better during this time, and I guess we can expect this trend to continue.

## Quart in a half-pint pot.....and material supply problems

From John Hayward, Northampton  
I have been a satisfied reader of M.E.W. for about 18 months and look forward every time to the next issue.

My workshop would make some of your contributors shudder, but in my 6ft. x 8ft. shed I have a 5in. Atlas lathe, an Alpine mill driller, 1/2in. bench drill, a small D.E. grinder, and an Alpine Universal bandsaw. Under one bench is my 140 amp stick welder and a small air compressor, and under the lathe are drawers holding drills, taps and dies, milling cutters, slot drills, and mills and reamers etc.

Below a large drawer holds my electric hand tools, and another holds my stock of steel, brass and aluminium. A metal cupboard holds various machine vices and my 6in. rotary table which I have converted to stand up as a divider.

You probably think it is a bit crowded; it is, but it is awfully ergonomic. Half a pace and you can face any machine.

Since reading your magazine, I have made the quick change tool holder with eight holders, this is a delight; the 3-way tailstock turret; a revolving centre and the vertical finisher, which I thought might come in handy, but seems to be in use for every job I tackle. The 2in. belts seem to be difficult to get but 4in. ones are easy, so I cut them in half with tin snips; doesn't half make a mess of the snips though.

Last thing from the book was the quick release for the clamps on the column on my Mill - what a cracker that is - I take my hat off to the designer.

My next job is the small bench guillotine, but have trouble in Northampton getting materials. The steel stockists have minimum orders of £25., and the scrap merchants won't let you go in the yard with all the new safety rules. When I lived in Slough I could pop into a steel supplier, pick up a bag of offcuts and end pieces, pay

cash and be set up for a year or so. I have visited the scrap merchants in Northampton and they seem to think we model engineers are a pain in the coccyx!!!

## Thoughts on going metric

From Pam White, Street, Somerset  
METRICATION -UGH!! But unfortunately it is here to stay. We will have to get used to it sooner or later. With this in view, I have purchased a digital vernier, and I find very good. I also have metric and Imperial micrometers. These are enough for my humble needs. The calibration collars on the lathe slides are removable and it won't be too difficult a job to make new ones calibrated in metric. The engraving of the lines can be done in the lathe using the gadget described in Model Engineer No. 3980. As regards conversion between the two, here are the conversion factors:

Inches to millimetres, multiply by 25.40  
Millimetres to inches, multiply by 0.03937

Perhaps readers would like to have BOTH Imperial AND metric dimensions on the drawings? Personally I think that you are right and we have got to come to terms with the metric system. It is all lot simpler in the long run, but it will mean adapting existing designs - but isn't this one of the essences of engineering?

From R. H. Hallam, Skellingthorpe, Lincoln.  
May I write to say how much I agree with Mr. J.M. Gurr's letter in M.E.W. No. 31?

I am sure there would be many people who would not bother to purchase copies of M.E.W. Nos. 20/21 as they too, would not appreciate why so much space (15 or more pages) should be devoted to a subject as C.A.D., as a model engineer's home workshop application. I too like to make something by my own efforts, rather than watching a C.N.C. do it for me. Obviously the Canadian reader must have bought the wrong magazine!

I personally had the impression that M.E.W. was short of scripted articles for issues 20/21, hence the lengthy C.A.D. feature. Surely so much more in the way of practical constructional features could have been used, especially as we are told space for articles is scarce.

With regard to drawings and articles submitted in metric dimensions, this is rather worrying when it is realised from the surveys made, that the majority of home workshops have machines and hand tools calibrated with Imperial readings. If metric dimensions are to be used for the minority of model engineers, then for the foreseeable future, these should be used as an equivalent alongside the Imperial dimensions. I agree, who can afford, even if one wanted to, to have machines and hand tools changed to metric readings.

I wonder if the model engineering press really appreciate how strongly model engineers feel on this subject, as I am sure, as Mr. Gurr says, there would be quite a number of people who would cancel their copies of M.E.W. if all future design projects were to be in metric only.

Some time ago I ordered some castings and drawings for a small project and the supplier asked if these were to be for metric or Imperial calibration. I replied "Imperial", and was told that this was the

answer they got in 75% of orders.

I have recently made quite a few visits to America and can say that the U.S.A. will never go metric in the foreseeable future!

From Jon Kutz, Lake Crystal, Michigan, U.S.A.

As a somewhat new subscriber, I was very pleased with the statement in your editorial in Issue 30 asking for metric dimensions on new projects. One of the main reasons I finally got around to subscribing to M.E.W. (and M.E.) is my desire for projects designed in metric. I am a charter subscriber to the Home Shop Machinist magazine here in the U.S., but they have not yet begun to have any projects in metric.

Back in 1988, when the U.S. Government passed new legislation making the metric system the 'preferred' system of measurement for all business and commerce in the U.S. and mandated the use of metric by all U.S. Government agencies, I made the decision to switch both my small business and my personal workshop to all metric. I decided that I would buy ONLY metric tools and equipment from that point on, with the goal of being 100% metric before the year 2000. Today, all temperature measuring equipment (thermostats, thermometers) read only in Celsius, all pressure gauges (water, air, hydraulic) read only in kilopascals and all linear measuring equipment measures only in millimetres (with the exception of electronic units which have both available - but switching to non-metric units is prohibited in our facility). Yes, there were (and still are) some instances where I may pay a small premium to get the metric goods (like the high shipping costs from England and Australia) but the long range saving from not having to replace these items at a later date with metric items (buying twice) is many times the small additional costs today. My business has taught me that I should never let short range considerations take precedence over long range needs.

When my business reached the point a few years ago where I needed a lathe and milling machine (which I could use nights and weekends for hobby work), I went looking for all metric machines (hand wheels, lead screws etc.). I did find one major importer of Asian machine tools that would sell me the all metric versions for the same price as the Imperial versions they stocked. I did have to wait about 3 months for the lathe and 5 months for the mill, but it was well worth the wait. If I decide to upgrade to new higher quality equipment in 5 or 10 years, my all metric machines will bring a premium price compared to Imperial measurement units, with the steady move to metric here in the U.S.A.

From Ray Stuart, Melton Mowbray, Leicestershire.

I noted the debate in the last issue of 'Model Engineers' Workshop' about the use of metric units with some interest. I remember some considerable time ago that there was a push for industry to go metric, and lots of items and catalogues displayed a metrication logo, which included the Union flag. Personally, I have never found the use of Imperial units easy,



I much prefer metric - believe it or not I actually find it easier to use, especially when adding measurement together. I hate having to convert from say  $\frac{1}{4}$ in. to 0.203125in. or 5.56mm in order to use the dials on my machines, (one of which incidentally only shows metric units), when I can only read them to two or possibly three decimal places. I suppose my 'Imperial phobia' relates to my scientific background, where almost all units are metric. Do those who advocate the continuing use of Imperial units also advocate a return to pounds shillings and pence, now that they have mastered decimal money? I think not.

One disadvantage of continuing to use Imperial units is that I believe it tends to discourage youngsters into the hobby, as they perceive it to be old fashioned and unattractive; my own children know not of these strange things called feet and inches or pounds and stones. If I mention them, I am accused of living in the stone age. "What's that in real units!" they cry.

I wholeheartedly support your desire to migrate to metric units.

### Arch Gibson's method of metric screwcutting (Issue 28)

From Derek Cooke, KATOOMBA New South Wales.

My retirement present to myself was a precision bench lathe, 5in. x 24in. (125 x 600mm). All the dials are metric, but I chose the model with an Imperial leadscrew, figuring that if I fell on hard times, I could always turn an honest quid making bits for obsolescent UK and US equipment. I have never regretted the choice, except on the rare occasions I have had to cut a metric thread! You may imagine that I looked at Arch Gibson's letter with more than passing interest.

A first reading left the mind boggled - mulling over relative speeds of mandrel and lead-screw. However, a second, and much more careful, reading and the whole thing became obvious. The method is virtually equivalent to leaving the half-nuts

clashed, and winding to and fro with the motor. In this case, after separation, the carriage is wound back to zero using the stop, and the leadscrew wound back to zero using a rev-counter. There is no particular merit in the 40 tooth indicator, except that one will have to cut 127mm of thread before the indicator mark comes round again, whereas No. 1 on the ordinary 16 tooth indicator will be around after only 50mm. This could prove confusing when cutting something like a lead screw. Also, when using the 40 tooth indicator, there will be no need to reverse the motor when cutting threads of 1.0, 0.5 or 0.25mm pitch. (WHY? - answer below).

The ideal method for cutting 'funny' threads, i.e. those not suited to the leadscrew, is to have a dog clutch between the mandrel and the train, one that can only be engaged at one point in the mandrel's revolution. The clasp nuts are left closed, and the carriage moved up and down by hand, treadle or motor. It is obvious that, wherever the carriage is, providing backlash has been taken up, the clutch can be disengaged, and cannot be re-engaged until an integral number of turns have been made by the mandrel, and the valley of the thread is once again opposite the tool. While I cannot put a clutch directly on the mandrel of my lathe, there is a spot just past the tumbler gears where one of the wheels is in step with the mandrel. One of these days.....

Meanwhile, I stick to the old method, running the mandrel at a brisk clip. Not having a quick stop fitted, when there is little room to manoeuvre, I fit a balanced mandrel handle and make the last few turns by hand. One would not use this method were someone else in the workshop! Stan Bray has come up with a brilliant solution to this problem. See issue 29.

Solution to problem:-

The pitch of an 8 tpi leadscrew is precisely 3.175 mm. This translates as a vulgar fraction of 127/40. (Fractions, particularly in dimensioned drawings are (rude word) vulgar, but occasionally have their uses). After the lead screw has

made 40 turns from the start of cutting a 1 mm pitch thread, the tool will have moved 127 mm, and the workpiece made exactly 127 revolutions. If we stop the machine at this point, it is obvious that we can undo the clasp nut, move the saddle back to the start, and we will find that the tool is opposite the thread valley and the arrow will be back on the mark. Whatever the length of thread cut, we only need to unclasp, wind back to the stop, and wait for the pointer to come opposite the index mark. What works for 1mm will obviously work for  $\frac{1}{2}$ mm and  $\frac{1}{4}$ mm.

Incidentally, I had always had the notion that 25.4 mm to the inch was a close approximation, and consequently the 127 tooth wheel gave a close approximation ( $127 = 5 \times 25.4$ ). It was only a few years back that I discovered that the 25.4 ratio was exact. Perhaps the powers that be got together and did something intelligent.

P.S. Has anyone out there got a good design for bringing a hefty 5in. lathe to a swift stop? It has a 1 HP single phase motor (250v.). I imagine that I would not be the only 'customer' for such a design.

### 'Griptru' Chuck instructions - A correction

From Alan Jeeves, Huddersfield  
An archer friend, who is also the owner of a Griptru chuck, pointed out to me that my arrow was pointing in the wrong direction! (Issue 27, page 17, Figure 2, Sketch of chuck).

This has also been highlighted by others. They are quite correct. When the adjusting screws are tightened, the chuck body moves in the opposite direction to that which I have indicated, and for which error I apologise. It would become immediately apparent upon first use, anyway.

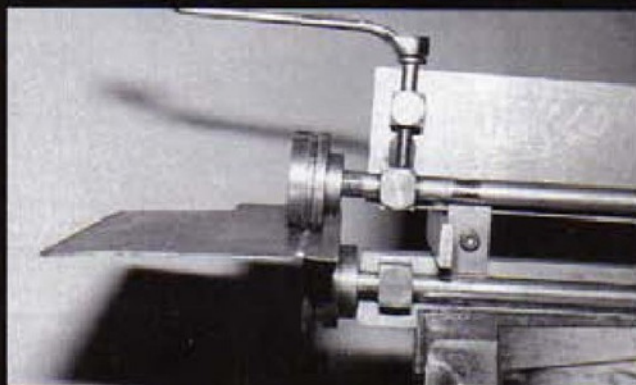
Please amend your magazines accordingly and do not let this oversight of mine deter you from obtaining one of these chucks if the opportunity arises.

# IN OUR NEXT ISSUE

Coming up in the JANUARY/FEBRUARY issue, No. 33, will be

### A SMALL JENNY OR SWAGGY MACHINE

Malcolm Leaf needed to produce some small sheets of corrugated-iron like material, so he designed a miniature version of the well known tin-smiths tool.



### X - Y TABLE UPDATE

Readers have asked for additional functions to be added to the x - y table control system. Ray Stuart upgrades the system to meet their requests.

### CROSS-DRILLING JIG.

Dyson Watkins describes a lathe attachment which will aid the accurate cross-drilling of round items.



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